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Research Document 2010/008 | **Document de recherche 2010/008**

Update of the 2009 Summer Scotian Shelf and Bay of Fundy Research Vessel Survey

Mise à jour sur le relevé d'été de 2009 effectué par un navire de recherche sur le plateau néo-écossais et dans la baie de Fundy

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Ce document est disponible sur l'Internet à:

ISSN 1499-3848 (Printed / Imprimé)
ISSN 1919-5044 (Online / En ligne)
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Correct citation for this publication:

Clark, D., J. Emberley, C. Clark, and B. Peppard. 2010. Update of the 2009 Summer Scotian Shelf and Bay of Fundy Research Vessel Survey. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/008. vi + 72 p.

ABSTRACT

The 2009 summer Scotian Shelf and Bay of Fundy research vessel (RV) survey was conducted between July 1 and July 28, 2009, onboard the *CCGS Alfred Needler*. The *Alfred Needler* completed 94 stations during the first leg of the survey, and 121 during the second leg. In Northwest Atlantic Fisheries Organization (NAFO) Divisions 4X5Y (strata 470-495), 77 valid tows were completed, while 119 valid tows were completed in NAFO Divisions 4VW (strata 440-466) and 6 sets were completed in strata 496-498 (Scotian Shelf edge; depth > 200fm). Hydrographic data were collected at all fishing stations.

There were 101 fish taxa identified from the trawl catch, and 118 invertebrate taxa. The number of invertebrate species in 2009 is slightly higher than in 2008, and was significantly higher than in the past. This was a result of a broader sampling strategy and the increasing experience of personnel in identification of invertebrates.

Details on data collected, protocols followed, areas covered and species captured are provided. Trends in abundance and biomass are presented for selected commercial species, as well as for species for which the data display a pronounced trend.

RÉSUMÉ

Le relevé d'été de 2009 effectué par un navire de recherche (NR) sur le plateau néo-écossais a été mené entre le 1er et le 28 juillet 2009 à bord du navire de la Garde côtière canadienne (*NGCC) Alfred Needler*. Le *Alfred Needler* a établi 94 stations d'échantillonnage pendant la première partie du relevé et 121 pendant la deuxième partie. Dans la division 4X5Y (strates 470 à 495) de l'Organisation des pêches de l'Atlantique Nord-Ouest (OPANO), 77 traits valides ont été réalisés, alors que 119 l'ont été dans la division 4VW de l'OPANO (strates 440 à 466) et 6 calées dans les strates 496 à 498 (bordure du plateau néo-écossais; profondeur supérieure à 200 brasses). En outre, des données hydrographiques ont été recueillies à toutes les stations de pêche.

Cent un (101) taxons de poissons et 118 taxons d'invertébrés ont été pris. Le nombre d'espèces d'invertébrés pris en 2009 est légèrement plus élevé qu'en 2008, et il a été beaucoup plus élevé que par le passé, ce qui s'explique d'une part par la stratégie d'échantillonnage plus vaste et, d'autre part, par l'expérience acquise par le personnel dans l'identification des invertébrés.

Des détails sur les données recueillies, les protocoles suivis, les zones couvertes et les espèces prises sont fournis. De plus, des tendances relatives à l'abondance, à la biomasse et à la zone occupée sont présentées pour certaines espèces commerciales et les espèces pour lesquelles les données montrent une tendance prononcée.

INTRODUCTION

The DFO summer Scotian Shelf and Bay of Fundy research vessel (RV) survey, hereafter referred to as the summer RV survey, has been conducted annually since 1970. The summer RV survey follows a stratified random sampling design, and includes both hydrographic sampling and sampling of fish and invertebrates using a bottom otter trawl. These survey data are the primary data source for monitoring trends in species distribution, abundance, and biological condition within the region, and also provide data to the Atlantic Zonal Monitoring Program (AZMP) for monitoring hydrographic variability. This document is intended to provide a synopsis of the findings of the 2009 survey and to examine these data in the context of long-term survey results.

The bottom trawl survey was designed to provide abundance trends for groundfish residing at depths from about 50m to 400 m. Survey indices are expected to be proportional to abundance for most species. The distribution of some species, however, such as cusk and turbot, may not be fully covered by the survey. Abundance trends for theses species may only provide indication of direction of change over time. Catches of pelagic species, such as herring, may also not reflect abundance trends. For all these species, other biological information, such as length and weight are still relevant and are available on divisional databases.

The survey area has been divided into three zones, based on oceanography and biogeography. Trends are shown for the entire survey area, and also for three separate regions: Eastern Scotian Shelf (4VW; strata 440-466), Western Scotian Shelf (4X East; strata 470-481), and Gulf of Maine/Bay of Fundy (4X West; strata 482-495). Differences in patterns of fish abundance and species composition are apparent for these regions during the survey.

Plots of the size and distribution of catches are provided for selected species and stratified average catches are compared with past results to provide a general overview of trends in abundance and biomass. For select commercial species where individual fish weights have been collected throughout most of the time series, trends in condition (Fulton's K; weight/length^3) are also included.

Data are presented for the major commercial species, for species that comprise a large part of the survey catch, and for species where the 2009 catch was either unusually high or low. The set of species examined to determine if catches in 2009 were unusual was restricted to those where the area occupied exceeded 7000 square nautical miles (approximately 1/7th of the surveyed area) in 2009, or averaged greater than this in the 1970s, the 1980s or the 1990s. The species examined were restricted in this manner to avoid rare species for which catches display high inter-annual variability.

Comparisons of stratified length frequencies for 2008 and 2009 to the long-term mean are also included for major commercial fish species. These data were summarized to assist in reviewing trends in abundance that are directly relevant to fisheries management when they are developing advice on allowable catch; hence, these data are grouped by the applicable stock management areas for each species.

SAMPLING OF TRAWL CATCH

Basic data, total numbers and weight caught, and length frequencies were collected from all successful sets according to instructions in the Groundfish Bottom Trawl Surveys Manual.

Length stratified samples for individual fish weight, one per centimeter (by sex if required), were taken from each set for all fish species. In addition, otoliths were taken from cod, haddock, pollock, white hake, silver hake, cusk and halibut. Maturity stages were assigned for silver hake. All sampling and set information were entered directly in a database with online data editing using an Oracle-based data entry system called the Groundfish Surveys at sea Entry system (GSE).

Stomachs were collected from selected species according to length stratified requirements. Identification of stomach contents was conducted at sea when possible while some stomachs were frozen for later analysis.

HYDROGRAPHIC OBSERVATIONS

At all successfully fished stations, and one unfished station, profiles of temperature, conductivity (salinity), oxygen concentration, fluorescence, and irradiance (PAR extinction) were obtained with a SBE-25 Conductivity, Temperature and Depth (CTD) meter fitted on a Carousel Rosette deployed by the CCGS Alfred Needler. Niskin bottles attached to the Rosette collected water from the bottom, 25m and 50m (intermediate depths) when possible, and from 5m (near surface) for the following sampling:

- 5m: salinity (x1), nutrients (x2), chlorophyll-a (x2) and oxygen determination (x2),
- 25m: nutrients (x2), chlorophyll-a (x2),
- 50m: nutrients (x2), chlorophyll-a (x2), and
- Bottom: salinity (x1), nutrients (x2), chlorophyll-a (x2) and oxygen determination (x2).

Oxygen measurements were performed after the CTD cast using an ORION 842 bench meter. Salinity determinations were made using a Guildline 'Portasal' salinometer. Chlorophyll-a samples were processed onboard with a Turner-Designs fluorometer. Surface temperatures were measured using a VEMCO SEATEMP temperature probe. VEMCO depth/temperature miniloggers were attached to the trawl to monitor bottom water/fishing depth temperature.

Additional sampling was undertaken for the AZMP. At 28 selected stations, vertical zooplankton tows (202 micron mesh ring-net) were made from bottom to surface.

The Halifax hydro station was occupied three times during the course of the mission. On each occasion the following sampling was conducted:

- Vertical CTD profile of the entire water column (including a fluorometer sensor and dissolved oxygen probe),
- Two vertical zooplankton net tows from bottom to surface; one with each of the 76 and 202 micron ring-nets,
- Secchi depth measurement, and
- Niskin bottles on CTD rosette sampled at 10 depths through the water column - samples analyzed for oxygen, nutrients, salinity, chlorophyll-a, and phytoplankton enumeration.

TRAWL MENSURATION

Scanmar sensors were used to document the trawl characteristics. Wing spread, door spread, headline height and clearance were all recorded for sets, when possible.

RESULTS

The annual summer RV survey was conducted on the CCGS Alfred Needler between July 1 and July 28, 2009. A total of 202 fishing stations were completed during the survey. In NAFO Divisions 4X5Y (strata 470-495), 77 valid tows were completed, while 119 valid tows were completed in NAFO Divisions 4VW (strata 440-466) and 6 sets were completed in strata 496-498 (Scotian shelf edge; depth > 200fm), (Fig. 1). Nine tows were designated as unrepresentative either due to net damage or because tow duration was less than 20 minutes.

The survey began on schedule but, due to mechanical problems, the first leg of the survey ended a day early. The second leg of the survey was completed on schedule with only a six hour delay due to a mechanical repair while at sea. Minimum sampling requirements were met for all strata.

There were 101 species of fish recorded during the survey (Table 2). The most frequently captured fish were American plaice, cod, haddock, silver hake, redfish and witch flounder while those contributing most to the weight caught were redfish, haddock, cod, pollock, spiny dogfish, and silver hake.

There were 118 separate invertebrate codes used during the survey (Table 3). This is slightly higher than 2008 and considerably greater than in 2006 when 63 invertebrate species were recorded. This was a result of a broader sampling strategy, and was accomplished through increasing experience of survey personnel in identification of invertebrates. The most frequently captured invertebrates were short-fin squid, sponges, pink shrimp *(Pandalus montagui)*, and snow crab while orange footed sea cucumbers, short-fin squid, northern shrimp (*Pandalus borealis)* and American lobster contributed most to the weight of the invertebrate catch.

Identification of all corals was verified in the lab at Bedford Institute of Oceanography (BIO) immediately following completion of the survey. Those which were listed as unidentified at-sea had the correct species designation added to the database. A large collection of invertebrates, along with a smaller number of fish were delivered to the Atlantic Reference Centre (ARC) for corroboration of at-sea identification. A variety of samples were collected in addition to those required as part of our standard sampling protocols (Table 4).

Distribution, Abundance and Condition of Sampled Species

Survey staff noted that catches of commercial species, haddock, cod and redfish in particular, were consistently higher than in recent years throughout the Scotian Shelf. While the high catches were a welcome sight, the extra time required to process these catches made it difficult to complete all of the sampling requirements that have been added to the survey objectives in recent years. Other noteworthy observations include the high catches of a suite of species on Browns Bank. These included larger catches of cod, haddock and pollock than have been observed there in recent years. The catches also included large numbers of short-fin squid and northern sand lance, which are unusual to find in this area. The Bay of Fundy did not share in this general increase in fish catch. Apart from winter flounder and white hake, catches of commercial fish species in the Bay of Fundy remained very low again in 2009.

Distribution, biomass, and condition trend plots are included for some of the more abundant fish and invertebrates species in the survey catch (Tables 2 and 3, Figures 3 to 35) and for other species of commercial importance.

Total biomass estimate for the survey is displayed in Figure 2. Data were not traditionally collected on all species; therefore, this estimate is restricted to all vertebrate species plus lobster and squid. The total biomass index for 4X west is variable but does not show a significant change over the time series. The total biomass index for 4X east was among the highest in the series in 2009, while in 4VW it was the highest since 1990. This estimate can be heavily influenced by a small number of species. For example, a large catch of dogfish from 4X east in 2007 resulted in the highest biomass estimate for this area in the time series. In 2009, this was not the case.

Individual Species Trends

An index of individual species summaries and associated figures is located in Table 1 of this document.

Large catches of **haddock** were obtained from sets off southwest Nova Scotia, and on offshore banks in 4W (Fig. 3a). Catches were small in the Bay of Fundy and Gulf of Maine, and the biomass index remains below average in 4X west (Fig. 3b). The biomass index is the highest in the survey series in 4VW, and fifth highest in 4X east. Biomass increased in all areas after the early 1990s and has fluctuated without trend in 4X east and 4VW. In 2009, biomass increased in all areas and was the highest in the series in 4VW. In 4VW, abundance was much higher than average for lengths above 30cm, although numbers were very low for lengths between 11 and 30cm (Fig 3c). In 4X east, haddock abundance was also high for lengths between 30–50cm and very low for lengths between 10–30cm (Fig. 3d). Abundance in 4X west (Fig. 3e) was below average for most lengths; the numbers are also down considerably since 2008. Condition of haddock continued to improve for 4X east, where it was above average in 2009. Condition remained below average in the other regions (Fig. 3f).

Atlantic cod were widespread in the survey area in 2009 and there were several sets where the catch exceeded 50kg in 2009 (Fig. 4a). Biomass indices in 2008 were the lowest in the time series. Biomass indices for 2009 increased for all regions and were the highest since 1989 in 4VW and since 1996 in 4X east (Fig. 4b). In 4X west, biomass remained well below average. Abundance indices for 4Vn were well below average for all lengths above 47cm, but they were well above average for smaller cod (Fig. 4c). In 4VsW, abundance was above average for lengths between 40cm and 61cm (Fig. 4d). Numbers were above average in 4X east for all lengths below 64cm, but they remained below average for most lengths in 4X west (Fig. 4e, f). Cod condition has fluctuated without trend in the Bay of Fundy. Condition had shown a declining trend in 4X east, but increased sharply in 2009 to the highest in the series. In 4VW, there is no clear trend in condition, and it remains lower than in the 1970s (Fig. 4g).

Most **pollock** were caught in the Gulf of Maine and near the 4X-4W line (Fig. 5a). Biomass indices remain high in all areas compared to the last decade, despite a decline in 4VW in 2009 (Fig. 5b). Pollock abundance is displayed for the geographic areas used in the assessment (Stone et al. 2009). In 2009, the abundance of pollock in the eastern assessment unit (4VW and 4Xmn) was the highest in the time series for lengths between 25cm and 31cm (Fig. 5c), a mode that is likely comprised of age one fish. However, the abundance of pollock was below average for all other lengths. Pollock abundance in the surveyed portion of the western assessment unit (4Xopqrs+5Yb+5Zc) was above average for lengths between 58cm and 82cm in both 2008 and

2009 but below average for most lengths less than 49cm (Fig. 5d). In all regions, there was a declining trend in pollock condition until the early 1990s and, since then, has remained lower but stable (Fig. 5f).

White hake were distributed throughout the survey area, with the largest catches in the Gulf of Maine, Bay of Fundy and off Cape North (Fig. 6a). Biomass indices display high inter-annual variability; they have declined in general since the mid 1980s, but have risen for the last two years in all regions (Fig. 6b). Abundance remained below average for all lengths for 4VW in 2008 and 2009 (Fig. 6c). In 4X east, abundance indices were above average for most lengths below 58cm in 2009 but below average for larger fish (Fig. 6d). This is similar to what was seen in 2008. White hake abundance indices in 4X west were near average for most lengths in both 2008 and 2009 (Fig. 6e).

Catches of **silver hake** in the 2009 survey were widespread, with the exception of the Eastern Scotian Shelf (Fig. 7a). The survey biomass index increased, and was above average in 2009, for 4X east and 4VW, but remained below average in 4X west (Fig. 7b). Indices of abundance are displayed for silver hake based on the assessment area, which comprises strata 440-483 (Showell et al. 2005). Abundance indices were at or above average for most lengths in 2009, with some increase in modal lengths from 2008 (Fig. 7c). Condition has increased since 2000 for silver hake in all regions surveyed. In 2009, condition was above average for 4X east but remained below average in 4X west and 4VW (Fig. 7d).

Large catches of **redfish** were wide-spread throughout the survey area (Fig. 8a) in 2009. In 2008, the biomass index was the highest in the series. The biomass index increased again in 2009 in 4X east and 4VW (Fig. 8b). The total 4VWX biomass index in 2009 is double what was caught in any year other than 2008. Abundance indices are displayed according to management areas (Branton 1999; Power 2000) and were above average for most lengths in 2009. A strong mode is apparent in the length frequency for both Unit II and Unit III (Figs. 8c and 8d). In the 2008 survey update, it was noted that there was some progression in modal length from 2007 to 2008, suggesting tracking of a strong year-class. In 2009, the modal length increased slightly again in Unit II, while in Unit III there was little change from 2008. There is no recent trend in condition in any region and condition in all regions remains lower than average (Fig. 8e).

Halibut catches were wide-spread in the survey area (Fig. 9a). Biomass reached a record high for the survey in 2007 and remains high for all regions in 2009 (Fig. 9b). Abundance was above average for most lengths below 110cm in both 2008 and 2009 (Fig. 9c).

Winter flounder were caught mainly in the Bay of Fundy with smaller catches also occurring on Browns Bank and Western Bank (Fig. 10a). Biomass indices increased slightly in both 4VW and 4X east for 2009, and they increased again in 4X west to the highest in the series (Fig. 10b). Abundance of winter flounder was above average at lengths below 40cm in 4X east, but very few were caught above this length (Fig. 10c). In 4X west, numbers were well above average at all lengths less than 36cm and near average above that (Fig. 10d).

American plaice were widespread on the Scotian Shelf during the 2009 survey with the largest catches primarily in 4V (Fig. 11a). Biomass remains low in 4X. Biomass has fluctuated at a low level in 4VW since 1995 and declined to near the lowest in the series in 2009 (Fig. 11b). In 2009, abundance at length in 4VW was below average for all lengths greater than 22cm (Fig. 11c).

Witch flounder were caught throughout the survey area, with one very large catch in 4Vn off the coast of Cape Breton (Fig. 12a). Witch flounder biomass has remained low in 4X since the

1980s. The biomass index in 2009 for 4X east remains below average, while in 4X west it was above average for the time-series, and the second highest since 1986. In 4VW, biomass has followed an increasing trend since the early 1990s, and it was the second highest in the series in 2009 (Fig. 12b). Witch flounder abundance in 4VW is well above average for most lengths below 40cm and generally higher than in 2008 (Fig. 12c). Abundance indices were below average for most lengths in 4X east in both 2008 and 2009, except at lengths less than 13cm in 2009 (Fig. 12d). Abundance indices in 4X west were above average for most lengths less than 46cm in both 2008 and 2009 (Fig. 12e). Larger witch flounder (> 46cm), which had constituted a large part of the survey catch in the past, continue to be absent from the survey catches.

Almost all of the 2009 **yellowtail flounder** catch came from 4VW, with a small percentage caught in 4X east (Fig. 13a). Yellowtail flounder biomass showed a declining trend up to 2003, at which point it reached a low. Biomass has since shown an increasing trend (Fig. 13b).

Spiny dogfish were caught almost exclusively in 4X west in 2009 (Fig. 14a). In 2009, the dogfish biomass index is among the lowest in the series; however, biomass estimates for dogfish are quite variable from year to year with no clear trend in the past decade (Fig. 14b).

The largest catches of **winter skate** came from Browns Bank and the Bay of Fundy in 2009 (Fig. 15a). Winter skate biomass remains at a low level (Fig. 15b).

Catches of **thorny skate** were made primarily in 4V in 2009 (Fig. 16a). The biomass indices in 2009 were the lowest in the series for thorny skate in both 4X west and 4VW, and near the lowest in 4X east (Fig. 16b).

Atlantic herring catches were widespread in the survey area in 2009 (Fig. 17a). The biomass index has dropped sharply in 4VW since 2004. Biomass indices show no clear trend for 4X east or 4X west (Fig. 17b). It is not clear that survey catches reflect population biomass for herring, due to their primarily pelagic distribution.

Argentine catches were more widespread in 2009 than in recent years, with catches along the shelf edge and in the Gulf of Maine (Fig. 18a). The biomass index remained among the lowest in the series in 2009 (Fig. 18b). As with herring, it is not clear if survey catches are reflecting population biomass trends for argentine. These species are primarily pelagic, and small changes in vertical distribution may strongly influence bottom trawl catches.

The largest **turbot** catches came from 4V and along the shelf edge (Fig. 19a). Biomass indices display an increasing trend since 1990 and have increased by two orders of magnitude in that period (Fig. 19b).

Cusk catches have declined throughout the survey series, and the biomass index for 2009 was the lowest in the series (Fig. 20).

Atlantic wolffish biomass has followed a declining trend since about 1980, and it was the lowest in the series in 2009 (Fig. 21).

Few **monkfish** were caught in the 2009 survey. The biomass index appears to be low but stable (Fig. 22).

The **red hake** biomass index has increased over the last five years in 4X east and was above average in 2009. The biomass indices show no recent trend for 4X west or 4VW and remained below average in 2009 (Fig. 23).

Biomass indices for **blackbelly rosefish** decreased to very low levels in 4X east and 4VW in 2009. The biomass index in 4X west in 2009 was among the highest in the series. The overall 4VWX biomass index has followed an increasing trend since 1990, with an increase of over two orders of magnitude (Fig. 24).

Northern sand lance biomass has followed a declining trend since 2000 in 4VW (Fig. 25). Sand lance were caught on Browns Bank in 4X east in 2009; while the biomass index is very low compared to 4VW, this represents the largest catch of sand lance in the series for 4X east.

Longhorn sculpin biomass indices have displayed no clear trend in 4VW in the last decade and remained well below average in 2009. Biomass indices have increased in both 4X east and 4X west and were above average in both areas in 2009 (Fig. 26).

Ocean pout biomass declined sharply in the 1990s and has remained low in all areas since 2000 with no recent trend (Fig. 27).

Biomass of **northern hagfish** displays high inter-annual variability. Biomass in 2008 and 2009 is below the recent average (1995–present) in all areas (Fig. 28).

American lobster and short-fin squid are the only invertebrates that were regularly sampled throughout the survey time series. Most other invertebrates in the catch have a shorter time series (1999-present).

American lobster was caught in most sets in 4X with very few catches in 4VW (Fig. 29a). Biomass in 4X east and 4X west remained among the highest in the series (Fig. 29b). In 4VW, biomass increased sharply from 2008 and in 2009 is an order of magnitude higher than in any other year. The increase in 2009 is primarily caused by one set near the shelf edge (Fig. 29a).

Short-fin squid were caught throughout the survey area, with the largest catches taken on Browns Bank and east of Emerald Basin (Fig. 30a). Survey catches show high inter-annual variability and are above average for 4X east and 4VW in 2009 (Fig. 30b).

Sea scallop catches came mainly from the upper Bay of Fundy, Browns Bank and Western Bank (Fig. 31a). The biomass index was the highest in the series in 4VW in 2009 and the lowest in the series in 4X east. Biomass has varied without trend in 4X west (Fig. 31b).

Catches of **snow crab** occurred primarily in the eastern portion of 4VW and were rarely encountered in 4X (Fig. 32a). Biomass in 4VW has been above average in both 2008 and 2009 (Fig. 32b).

Pink shrimp *(Pandalus montagui)* were distributed widely throughout the survey area (Fig. 33). **northern shrimp** (*Pandalus borealis*) were primarily found in 4VW (Fig. 34).

Orange footed sea cucumber (*Cucumaria frondosa*) were caught primarily in 4VW with the largest catches by weight taken from Banquereau (Fig. 35a). The biomass index for sea cucumber has been stable since 2007 at a high level (Fig. 35b). The survey catch of orange footed sea cucumber in 4VW is among the highest for any species, ranking behind only cod, haddock and redfish in 2009.

Bottom Temperature and Salinity

Temperature and salinity data were collected at each station from the 2009 survey. Contour plots of these data show general patterns of water masses in the region (Fig. 36a, 37a). The general patterns are consistent with past years with the coldest water on the Eastern Scotian Shelf, warm saline water in the Central Scotian Shelf and Georges Basin, and warm water of low salinity in the Bay of Fundy. Average temperature by stratum in 2009 was compared with the long-term average from 1970-2008. The strata surrounding Sable Island had slightly higher than average temperatures while strata near Lahave Basin and Lahave Bank were slightly lower than average (Fig. 36b). Average salinity by stratum in 2009 was also compared with the long-term average from 1970-2008. Salinity in 2009 fit quite well with the long-term average (Fig. 37b). Overall, there were no striking deviations from the longterm average of temperature or salinity.

CONCLUSIONS

While the total number of valid tows completed remained low, at 202, the minimum sampling requirements were met in all strata during the 2009 survey.

Increased effort on identification of invertebrates has resulted in a much higher number of invertebrate species recorded. Further development of field identification guides is needed to ensure these species can be recorded consistently on future surveys.

The total biomass (all vertebrates plus lobster and short-fin squid) observed in the survey increased substantially in 4VW in 2009 and is among the highest in the time series in 4X east. Total biomass has varied without trend in 4X west. The divergence between 4X west and the other two areas seems to reflect increased catches of haddock, cod and redfish on the Scotian Shelf. Biomass indices remain low for these species in 4X west.

For some species the trends were consistent among regions. Biomass was low for cusk, monkfish, striped Atlantic wolffish, ocean pout, thorny skate, dogfish and American plaice in all three regions, and was above the median catch for redfish, halibut, turbot, sand lance and lobster.

Many of the species that are above average biomass are found primarily in deep water, but not all deep water species show this trend. Deep water species like cusk, monkfish and white hake are currently at very low biomasses, while turbot and blackbelly rosefish have effectively moved into shallower waters and colonised parts of the Scotian Shelf. The trends in their abundance at depths greater than 500m–700m is unknown.

In 4X east, above average biomass was recorded for a wider variety of species, including deep water species, species associated with shallow coastal waters, and species such as winter flounder and longhorn sculpin, which are caught at a variety of depths. During the 2009 survey in 4X east, many species were at a low biomass. However, the major commercial species, haddock, cod, pollock, white hake, silver hake, redfish, halibut and lobster, were all above the average biomass.

The survey data are available on the Maritimes Regional Ecosystem Survey database for more detailed analyses.

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Thorny Skate (*Amblyraja radiata*)	8	54
Herring (*Clupea harengus*)	8	56
Argentine (*Argentina silus*)	8	58
Turbot (*Reinhardtius hippoglossoides*)	8	60
Cusk (*Brosme brosme*)	8	61
Striped Wolffish (*Anarhichas lupus*)	8	62
Monkfish (*Lophius americanus*)	8	62
Red Hake (*Urophycis chuss*)	8	63
Blackbelly Rosefish (Helicolenus *dactylopterus*)	8	63
Northern Sand Lance (*Ammodytes dubius*)	9	64
Longhorn Sculpin (*Myoxocephalus octodecemspinosus*)	9	64
Ocean Pout (*Macrozoarces americanus*)	9	65
Hagfish (*Myxine glutinosa*)	9	65
Lobster (*Homarus americanus*)	9	66
Short-fin Squid (*Illex illecebrosus*)	9	67
Sea Scallop (*Placopecten magellanicus*)	9	68
Snow Crab (*Chionoecetes opilio*)	9	69
Pandalus montagui [Pink Shrimp]	9	70
Pandalus borealis [Northern Shrimp]	9	71
Orange footed Sea Cucumber (*Cucumaria frondosa*)	9	71

Table 2. Summary of vertebrate catch from the 2009 summer RV survey.

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples	Stomach Samples
40	American Plaice	*Hippoglossoides platessoides*	136	608	3903		444
10	Cod(Atlantic)	*Gadus morhua*	119	4787	5641	799	329
11	Haddock	*Melanogrammus aeglefinus*	114	14167	20582	1478	490
14	Silver Hake	*Merluccius bilinearis*	109	1695	13641	1311	310
23	Redfish Unseparated	*Sebastes*	104	18894	110426		319
41	Witch Flounder	*Glyptocephalus cynoglossus*	104	754	3900		202
60	Herring(Atlantic)	*Clupea harengus*	99	1069	8932		
12	White Hake	*Urophycis tenuis*	82	791	1060	608	247
42	Yellowtail Flounder	*Limanda ferruginea*	76	886	5606		191
300	Longhorn Sculpin	*Myoxocephalus octodecemspinosus*	72	309	1894		123
16	Pollock	*Pollachius virens*	58	2298	2369	305	126
13	Squirrel or Red Hake	*Urophycis chuss*	55	63	378		70
320	Sea Raven	*Hemitripterus americanus*	54	221	344		65
201	Thorny Skate	*Amblyraja radiata*	53	130	279		91
30	Halibut(Atlantic)	*Hippoglossus hippoglossus*	46	365	84	80	63
610	Northern Sand Lance	*Ammodytes dubius*	46	191	11388		88
43	Winter Flounder	*Pseudopleuronectes americanus*	44	466	1743		65
202	Smooth Skate	*Malacoraja senta*	43	49	161		64
340	Alligatorfish	*Aspidophoroides monopterygius*	43	<1	186		
220	Spiny Dogfish	*Squalus acanthias*	33	2216	1214		57
400	Monkfish,Goosefish,Angler	*Lophius americanus*	33	99	63		41
640	Ocean Pout(Common)	*Macrozoarces americanus*	32	15	75		26
31	Turbot,Greenland Halibut	*Reinhardtius hippoglossoides*	31	428	667		118
62	Alewife	*Alosa pseudoharengus*	27	19	166		
241	Northern Hagfish	*Myxine glutinosa*	26	4	68		
623	Daubed Shanny	*Lumpenus maculayus*	26	4	722		32
114	Fourbeard Rockling	*Enchelyopus cimbrius*	23	1	42		4
112	Longfin Hake	*Urophycis chesteri*	22	37	538		55
304	Mailed Sculpin	*Triglops murrayi*	22	1	52		
204	Winter Skate	*Leucoraja ocellata*	19	164	402		15
50	Striped Atlantic Wolffish	*Anarhichas lupus*	18	31	34		
410	Marlin-Spike Grenadier	*Nezumia bairdii*	18	4	174		22
203	Little Skate	*Leucoraja erinacea*	16	90	288		27

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples	Stomach Samples
880	Hookear Sculpin,Atl.	*Artediellus atlanticus*	15	<1	65		
61	Shad American	*Alosa sapidissima*	14	98	135		
160	Argentine(Atlantic)	*Argentina silus*	13	69	230		14
63	Rainbow Smelt	*Osmerus mordax*	12	1	160		2
317	Ribbed Sculpin	*Troglops pingeli*	12	1	53		
622	Snake Blenny	*Lumpenus lumpretaeformis*	12	4	132		20
701	Butterfish	*Peprilus triacanthus*	12	1	22		
150	Lanternfish (NS)	*Mtctophidae*	11	1	347		
619	Eelpout,Newfoundland	*Lycodes terraenova*	10	10	95		11
123	Rosefish(Black Belly)	*Heligolenus dactylopterus*	9	31	146		9
350	Atlantic Sea Poacher	*Leptagonus decagonus*	9	1	30		
712	White Barracudina	*Notolepis rissoi*	9	1	96		
64	Capelin	*Mallotus villosus*	8	39	1951		7
200	Barndoor Skate	*Dipturus laevis*	7	68	10		4
647	Shorttailed Eelpout(Vahl)	*Lycodes vahlii*	7	4	39		10
625	Radiated Shanny	*Ulvaria subbifurcata*	6	<1	24		
17	Tomcod(Atlantic)	*Microgadus tomcod*	5	5	70		7
19	Off-Shore Hake	*Merluccius albidus*	5	9	11		3
143	Brill/Windowpane	*Scophthalmus aquosus*	5	3	13		
159	Boa Dragonfish	*Stomias boa*	5	3	153		
501	Lumpfish	*Cyclopterus lumpus*	5	17	22		1
602	Gray's Cutthroat Eel	*Synaphobranchus kaupi*	5	1	28		
604	Snipe Eel	*Nemichthys scolopaceus*	5	<1	22		
301	Shorthorn Sculpin	*Myoxocephalus scorpius*	4	4	6		1
603	Wolf Eelpout	*Lycenchelys verrilli*	4	<1	4		
314	Spatulate Sculpin	*Icelus spatula*	3	<1	3		
505	Seasnail,Gelatinous	*Liparis fabricii*	3	<1	4		
630	Wrymouth	*Cryptacanthodes maculatus*	3	2	3		
646	Atlantic Soft Pout	*Melanostigma atlanticum*	3	<1	6		
70	Mackerel(Atlantic)	*Scomber scomerus*	2	<1	2		
221	Black Dogfish	*Centroscyllium fabricii*	2	14	52		
306	Snowflake Hookear Sculpin	*Artediellus unciaatus*	2	<1	4		
323	Hookear Sculpin (NS)	*Artediellus*	2	<1	3		
502	Atlantic Spiny Lumpsucker	*Eumicrotermus spioosus*	2	<1	2		
512	Seasnail,Dusky	*Liparis gibbus*	2	<1	2		

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number	Age Samples	Stomach Samples
620	Laval's Eelpout	*Lycodes lavalaei*	2	1	11		1
714	Simonyi's Frostfish	*Benthodesmus simonyi*	2	<1	2		
924	Sea Tadpole	*Careproctus ranula*	2	<1	2		
15	Cusk	*Brosme brosme*	1	2	1	1	1
44	Gulf Stream Flounder	*Citharichthys arctifrons*	1	<1	1		
52	Northern Wolffish	*Anarhichas denticulatus*	1	<1	1		
111	Spotted Hake	*Urophycis regia*	1	<1	0		
115	Threebeard Rockling	*Gaidropsarus ensis*	1	<1	9		
142	Fourspot Flounder	*Hippoglossina oblonga*	1	2	2		
156	Short-Nose Greeneye	*Chlorophthalmus agassizi*	1	<1	1		
177	Loosejaw	*Malacosteus niger*	1	<1	1		
223	Portuguese Shark	*Centroscymnus coelolepis*	1	<1	2		
239	Deepsea Cat Shark	*Appristurus profundorum*	1	1	1		
240	Sea Lamprey	*Petromyzon marinus*	1	<1	1		
286	Benthosema sp.	*Benthosema*	1	<1	3		
303	Grubby or Little Sculpin	*Myoxocephalus aenaeus*	1	<1	8		
361	Threespine Stickleback	*Gasterosteus aculeatus*	1	<1	1		
412	Roughnose Grenadier	*Trachyrincus murrayi*	1	<1	1		
508	Inquiline Seasnail	*Liparis inquilinus*	1	<1	1		
511	Blacksnout Seasnail	*Paraliparis copei*	1	<1	1		
556	Longspine Snipefish	*Macrorhamphosus scolopax*	1	<1	1		
662	Spiny Eels (NS)	*Notacanthidae*	1	1	0		
700	Atlantic Silver Hatchfish	*Argyropelecus aculeatus*	1	<1	1		
704	American John Dory	*Zenopsis ocellata*	1	<1	0		
708	Polyipnus asteroides	*Polyipnus asteroides*	1	<1	1		
709	Transparent Hatchetfish	*Sternoptyx diaphana*	1	<1	1		
725	Atlantic Gymnast	*Xenodermichthys copei*	1	<1	1		
740	Spiny Eel	*Notacanthus chemnitzii*	1	1	1		
743	American Barrelfish	*Hyperoglyphe perciformis*	1	2	7		
805	Tonguefish	*Symphurus*	1	<1	1		
859	Melanostomias sp.	*Melanostomias*	1	<1	1		
866	Xenolepidichthys dalgleishi	*Xenolepidichthys dalgleishi*	1	<1	1		
1054	Duckbill Barracudina	*Paralepis atlantica kroyer*	1	<1	4		

Table 3. Summary of invertebrate catch from the 2009 summer RV survey.

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
4511	Short-fin Squid	*Illex illecebrosus*	127	1176	13492
8600	Sponges	*Porifera*	104	142	489
2212	Pandalus montagui [Pink Shrimp]	*Pandalus montagui*	101	325	93823
2526	Snow Crab (Queen)	*Chionoecetes opilio*	78	318	2429
6117	Hippasteria phrygiana	*Hippasteria phrygiana*	76	54	348
6411	Strongylocentrotus droebachiensis [Green Sea Urchin]	*Strongylocentrotus droebachiensis*	66	181	584
2559	Hermit Crabs	*Paguridae*	61	6	166
8300	Sea Anemone	*Anthozoa*	61	57	270
2550	American Lobster	*Homarus americanus*	53	496	465
4521	Octopus	*Octopoda*	52	3	164
6123	Sun Star	*Crossaster papposus*	52	24	259
2211	Pandalus borealis [Northern Shrimp]	*Pandalus borealis*	51	996	134666
2527	Toad Crab	*Hyas araneus*	45	7	213
6611	Cucumaria frondosa [Orange Footed Sea Cucumber]	*Cucumaria frondosa*	44	1965	818
6115	Mud Star	*Ctenodiscus crispatus*	43	16	582
6500	Sand Dollars	*Clypeasteroida*	42	35	680
2511	Jonah Crab	*Cancer borealis*	41	27	136
6121	Purple Sunstar	*Solaster endeca*	41	15	136
8500	Jellyfishes	*Scyphozoa*	41	25	40
4321	Sea Scallop	*Placopecten magellanicus*	39	68	998
2513	Atlantic Rock Crab	*Cancer irroratus*	36	29	322
6113	Leptasterias polaris	*Leptasterias polaris*	36	40	164
6111	Purple Starfish	*Asterias vulgaris*	34	49	253
6200	Brittle Star	*Ophiuroidea*	34	10	588
2411	Argis dentate	*Argis dentata*	33	16	3955
6300	Basket Stars	*Gorgonocephalidae, Asteronychidae*	31	78	18
1823	Sea Potato	*Boltenia*	30	11	169
2523	Northern Stone Crab	*Lithodes maja*	29	17	73
6120	Henrica	*Henrica*	29	<1	117
4210	Whelks	*Buccinum*	28	21	39
6110	Asterias	*Asterias*	27	17	252
2521	Hyas coarctatus	*Hyas coarctatus*	26	13	220

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
4227	New England Neptune	*Neptunea decemcostata*	24	3	36
6100	Asteroidea	*Asteroidea*	23	3	201
1810	Tunicata	*Tunicata*	22	9	41
6131	Diplopteraster multiples	*Diplopteraster multipes*	22	9	127
8318	Sea Pen	*Pennatulacea*	22	23	101
2221	Pasiphaea multidentata	*Pasiphaea multidentata*	20	11	4629
2313	Spirontocaris liljeborgii	*Spirontocaris liljeborgii*	20	1	1222
4536	Sepiolodae	*Sepiolodae*	20	<1	32
6119	Blood Star	*Henricia sanguinolenta*	20	2	55
6125	Pteraster militaris	*Pteraster militaris*	20	1	68
3212	Aphrodita	*Aphrodita*	17	10	64
4228	Spindle Shell	*Colus*	16	1	24
4322	Iceland Scallop	*Chlamys islandica*	16	3	49
6600	Sea Cucumbers	*Holothuroidea*	16	339	33
8347	Psilaster andromeda	*Psilaster andromeda*	16	4	1508
2990	Barnacles	*Cirripedia*	15	13	113
2600	Krill Shrimp	*Euphausiacea*	14	9	23719
8346	Pseudarchaster parelii	*Pseudarchaster parelii*	14	1	116
4211	Wave Whelk,Common Edible	*Buccinum undatum*	13	1	25
8324	Sea Cauliflower, Strawberries	*Eunephthya rubiformis*	13	<1	9
3200	Sea Mouse	*Aphrodita hastata*	11	<1	168
8315	Tealia Felina	*Tealia felina*	11	5	18
2417	Crangon septemspinosa	*Crangon septemspinosa*	9	<1	155
5100	Sea Spider	*Pycnogonida*	9	<1	68
8311	Metridium senile	*Metridium senile*	9	1	30
2312	Lebbeus polaris	*Lebbeus polaris*	8	<1	82
2415	Pontophilus norvegicus	*Pontophilus norvegicus*	8	<1	40
8100	Comb jellies	*Ctenophora*	8	<1	56
4221	Northern Moonsnail	*Euspira heros*	7	1	8
2414	Sclerocrangon boreas	*Sclerocrangon boreas*	6	<1	24
4330	Mussels (NS)	*Mytilidae*	6	5	5
2316	Spirontocaris spinus	*Spirontocaris spinus*	5	<1	257
2332	Eualus fabricii	*Eualus fabricii*	5	1	1122
2980	Red Isopod	*Isopoda*	5	<1	2

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
3100	Bristle Worms	*Polychaeta*	5	<1	8
4312	Bank Clam	*Cyrtodaria siliqua*	5	1	5
4314	Morrhua venusna	*Pitar morrhuana*	5	1	18
6129	Poraniomorpha hispida	*Poraniomorpha hispida*	5	<1	25
6511	Echinarachnius parma	*Echinarachnius parma*	5	2	49
8327	Soft Coral Unidentified	*Soft coral unidentified*	5	<1	6
8335	Cup Coral	*Flabellum*	5	1	25
1815	Molgulidae	*Molgulidae*	4	11	13
2319	Lebbeus groenlandicus	*Lebbeus groenlandicus*	4	<1	113
2331	Eualus macilentus	*Eualus macilentus*	4	1	221
2532	Red Deepsea Crab	*Chaceon quinquedens*	4	9	42
4304	Ocean Quahaug	*Arctica islandica*	4	<1	6
8325	Gold-Banded/Bamboo Coral	*Keratoisis ornata*	4	1	4
8329	Acanella arbuscula	*Acanella arbuscula*	4	<1	2
2213	Atlantopandalus propinqvus	*Atlantopandalus propinqvus*	3	<1	99
2333	Eualus gaimardii	*Eualus gaimardii*	3	<1	102
2421	Sabinea septemcarinata	*Sabinea septemcarinata*	3	<1	11
2610	Euphausiidae	*Euphausiidae*	3	2	267
3138	Sabellidae	*Sabellidae*	3	1	1
4328	Anomiidae	*Anomiidae*	3	<1	53
4331	Common Mussels	*Mytilus edulis*	3	<1	21
4514	Squid (NS)	*Loliginidaw, ommastrephidae*	3	<1	10
6413	Heart Urchin	*Brisaster fragilis*	3	1	28
2100	Shrimps	*Decapoda o.*	2	2	1833
2416	Crangon	*Crangon sp.*	2	<1	6
2555	Munida iris	*Munida iris*	2	<1	5
2556	Munida valida	*Munida valida*	2	<1	1
4212	Silky buccinum	*Buccinum scalariforme*	2	<1	2
4400	Sea Slugs	*Nudibranchia*	2	<1	2
6211	Daisy	*Ophiopholis aculeata*	2	<1	1
8322	Sea Corn	*Primnoa resedaeformis*	2	<1	0
8323	Bubble Gum Coral	*Paragorgia arborea*	2	<1	6
8338	Chrysogorgia agassizii	*Chrysogorgia agassizii*	2	<1	1
8700	Siphonophora	*Siphonophora*	2	1	0
1826	Sea Grapes	*Molgula manhattensis*	1	<1	6

Species Code	Common Name	Scientific Name	Sets Occupied	Total Weight (Kg)	Total Number
1827	Sea Peach	*Halocynthia pyriformis*	1	<1	2
1930	Lampshells	*Bryozoans, brachiopoda*	1	<1	4
2200	Pandalidae	*Pandalidae*	1	<1	3
2363	Acanthephyra exemia	*Acanthephyra exemia*	1	<1	1
2560	Paguroidea	*Paguroidea*	1	<1	0
2811	Gammaridae	*Gammaridae*	1	<1	1
2999	Isopod	*Calathura branchiata*	1	<1	11
3159	Ophelia	*Ophelia*	1	<1	0
3501	Lepidonotus squamatus	*Lepidonotus squamatus*	1	<1	1
4260	Amauropsis islandica	*Amauropsis islandica*	1	<1	0
4317	Bar,Surf Clam	*Spisula solidissima*	1	<1	1
4332	Horse Mussels	*Modiolus modiolus*	1	<1	1
4700	Chitons	*Polyplacophora*	1	<1	1
6713	Scarlett psolus	*Psolus fabricii*	1	<1	1
8330	Radicipes gracilis	*Radicipes gracilis*	1	<1	1
8400	Hydrozoa	*Hydrozoa*	1	<1	0
8601	Russian Hats	*Vazella pourtalesi*	1	2	1

Table 4. Special sampling conducted during the 2009 summer RV survey.

White Hake fin clips ≥ 40cm	49 samples collected in 4Vn 4 samples collected in 4Vs 66 samples collected in 4W 80 samples collected in 4X
Fin clips from variety of species	Samples collected from: Dogfish, Tom Cod, Atlantic Herring, Atlantic Halibut, Greenland Halibut/Turbot, Atlantic Cod, Haddock, Red Hake, Silver Hake, White Hake, Pollock, Ocean Pout, Winter Skate, Little Skate, Thorny Skate, Smooth Skate, Redfish, Monkfish, Yellowtail Flounder, Brill/Windowpane Flounder, Witch Flounder, Winter Flounder, American Plaice
Wolffish	35 whole specimens collected
Cod	20 whole specimens collected
Coral and Sponge	Samples collected of all species encountered per set
Sea Urchin	Up to 20 specimens collected from each set
Gastropods	All specimens collected
Sea Cucumbers	All species except *C. frondosa* collected
Identification (ARC)	Variety of vertebrate and invertebrate specimens collected

FIGURES

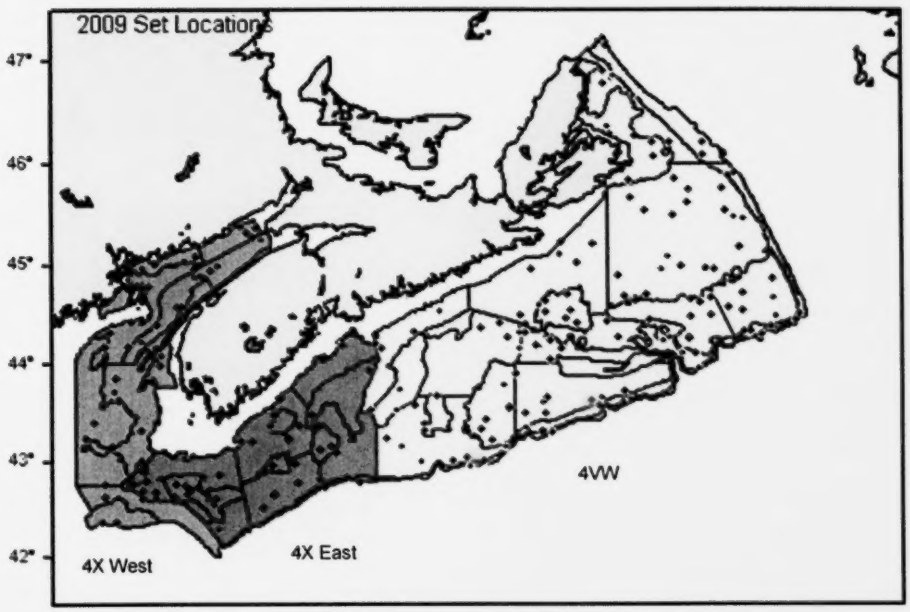

Figure 1. Station locations and geographical zones from the 2009 summer RV survey (Blue=4X West, Green=4X East, Yellow=4VW).

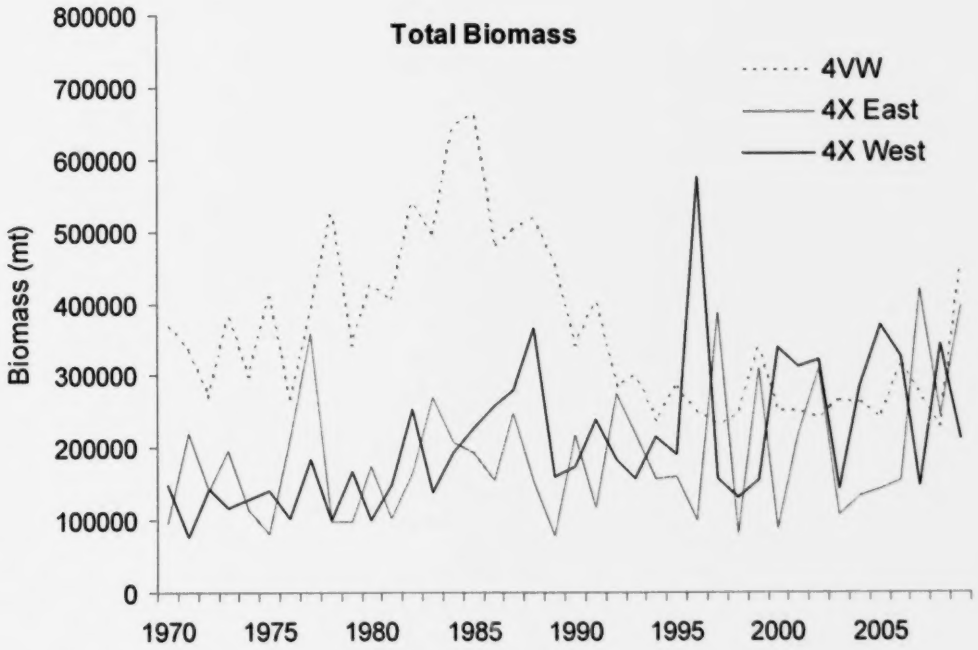

Figure 2. Total biomass estimate from the summer RV survey.

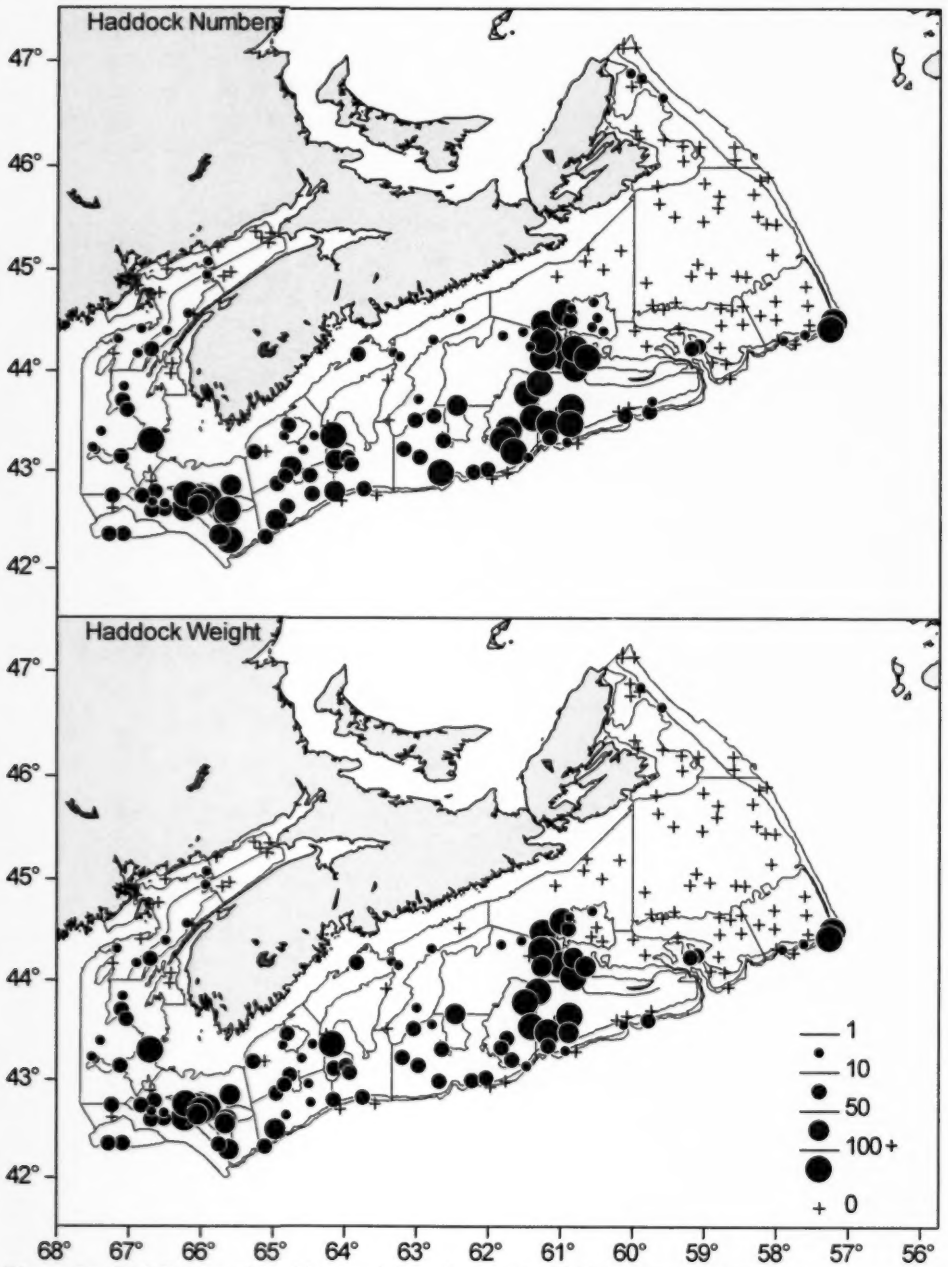

Figure 3a. Distribution of haddock catches during the 2009 summer RV survey.

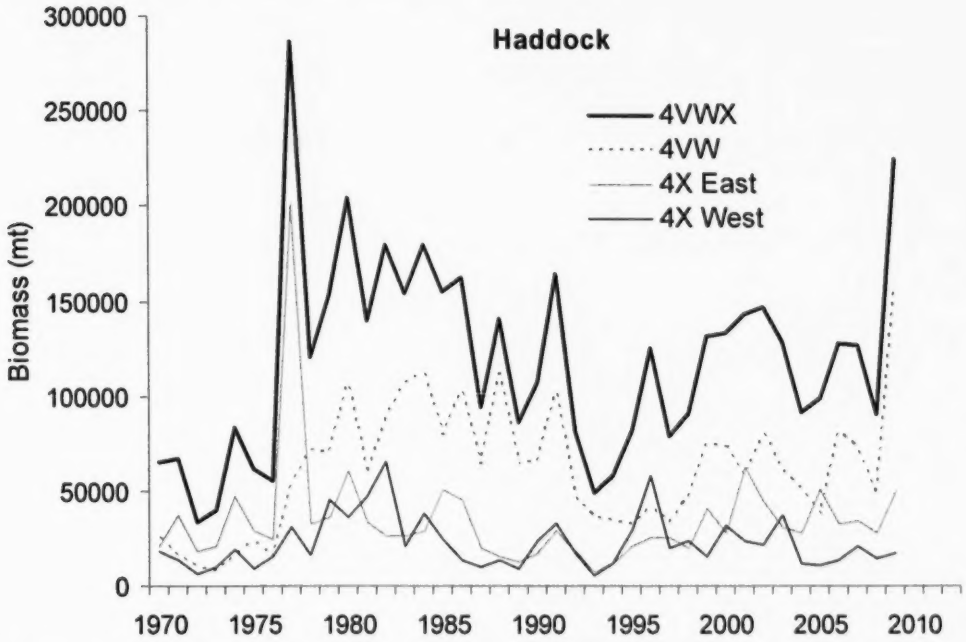

Figure 3b. Biomass estimate for haddock from the summer RV survey.

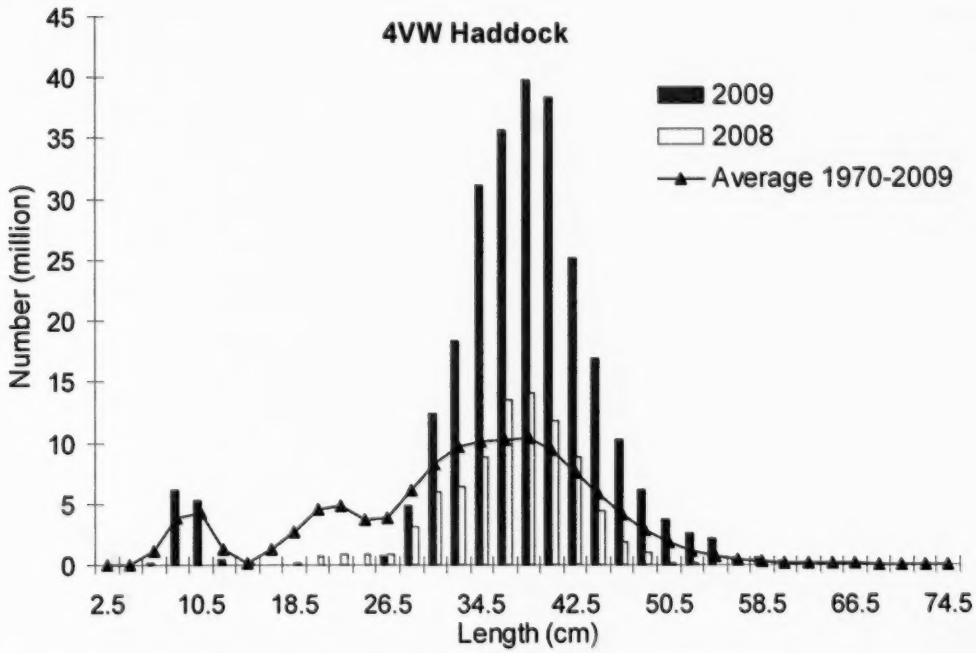

Figure 3c. Length composition for haddock in 4VW from the summer RV survey.

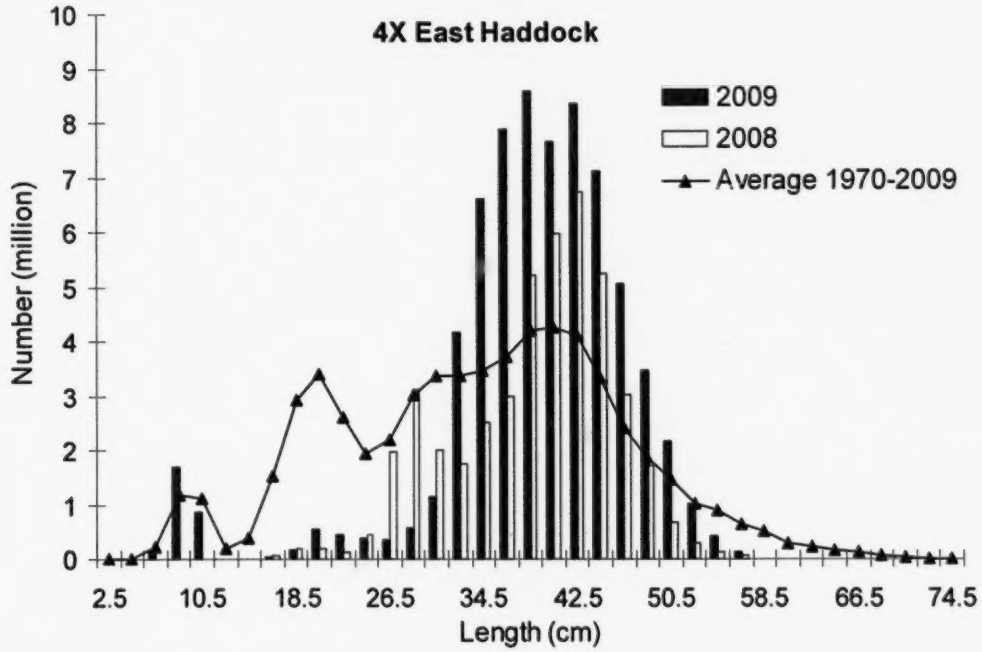

Figure 3d. Length composition for haddock in 4X East from the summer RV survey.

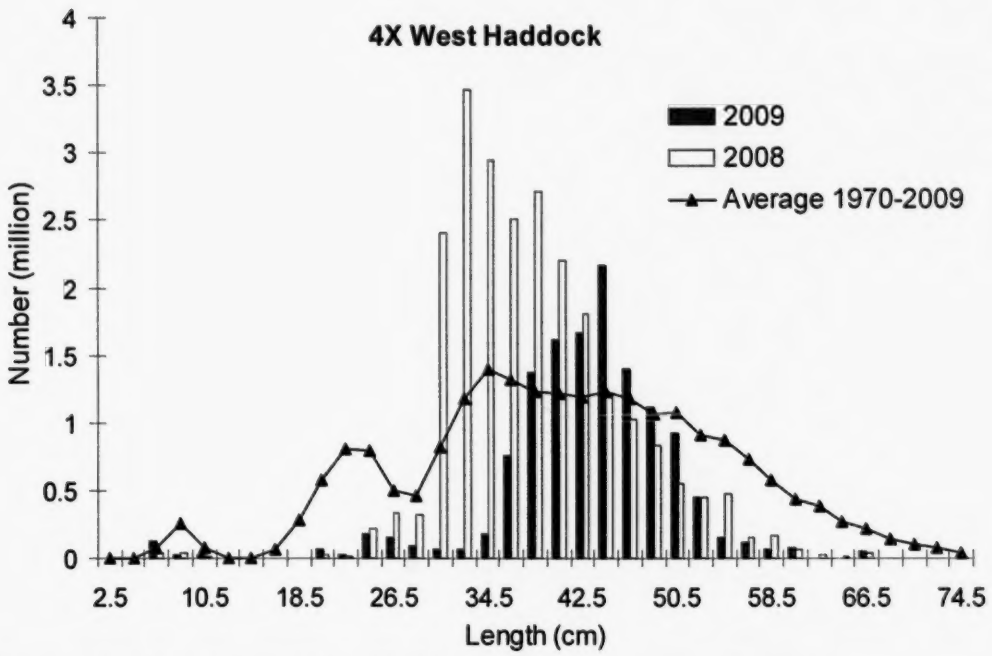

Figure 3e. Length composition for haddock in 4X West from the summer RV survey.

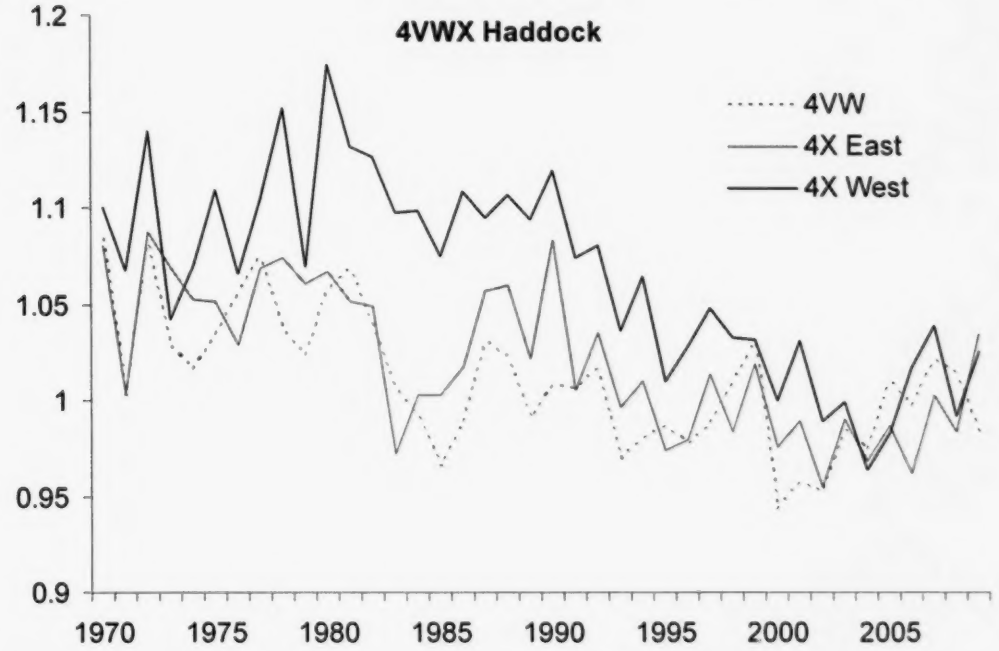

Figure 3f. Condition factor (Fulton's K) for haddock from the summer RV survey.

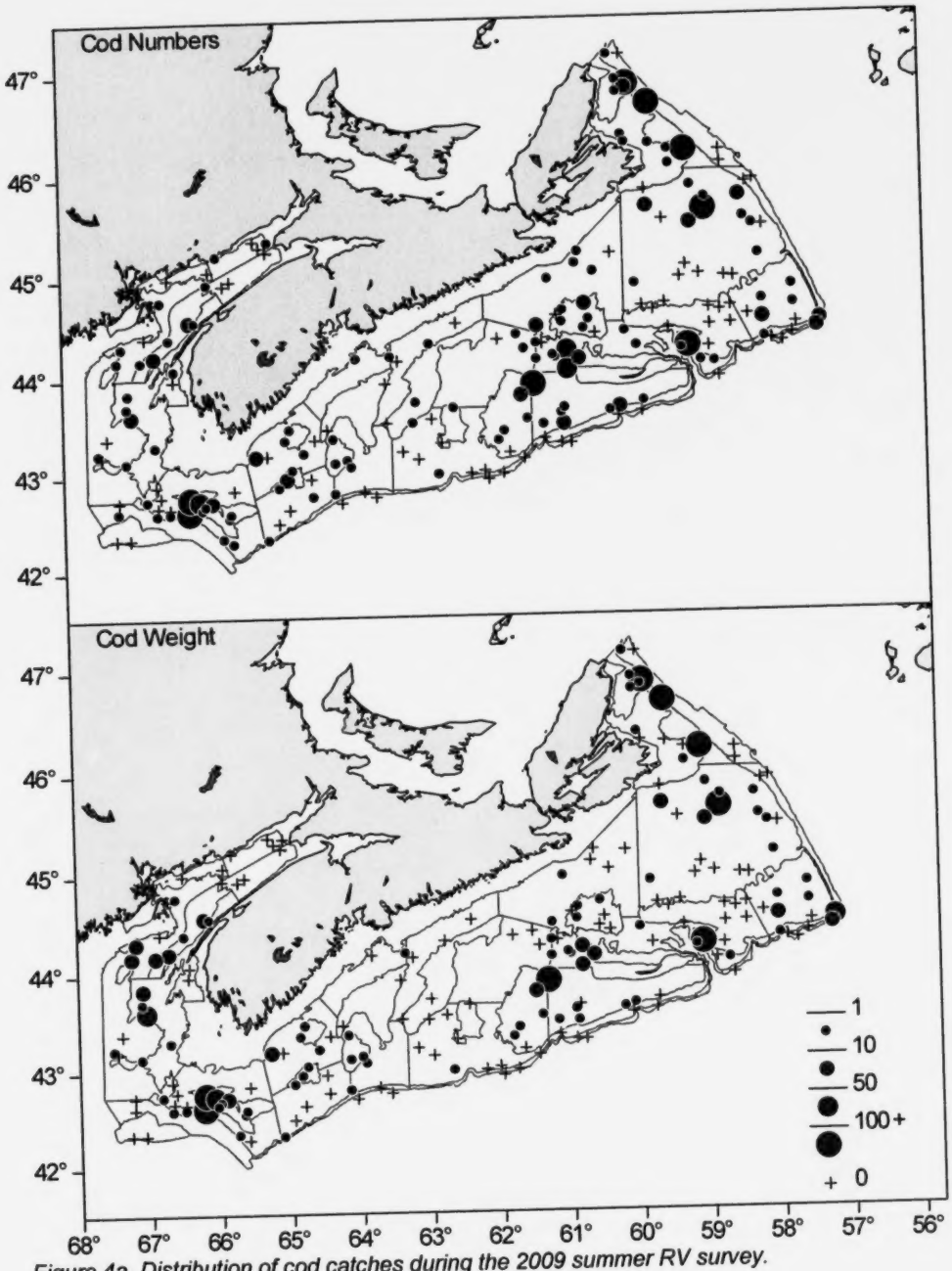

Figure 4a. Distribution of cod catches during the 2009 summer RV survey.

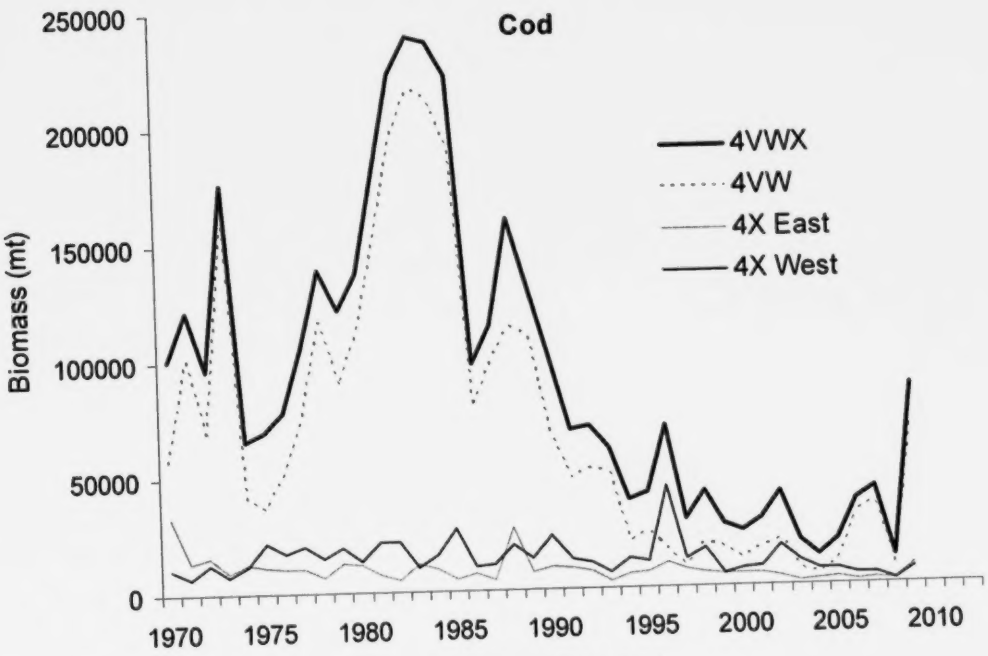

Figure 4b. Biomass estimate for cod from the summer RV survey.

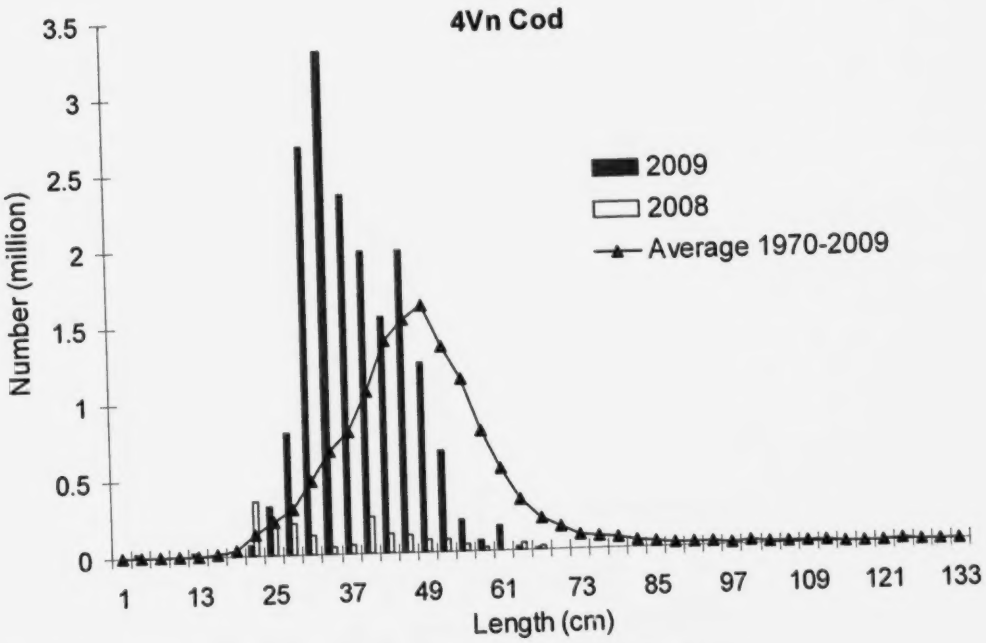

Figure 4c. Length composition for cod in 4Vn from the summer RV survey.

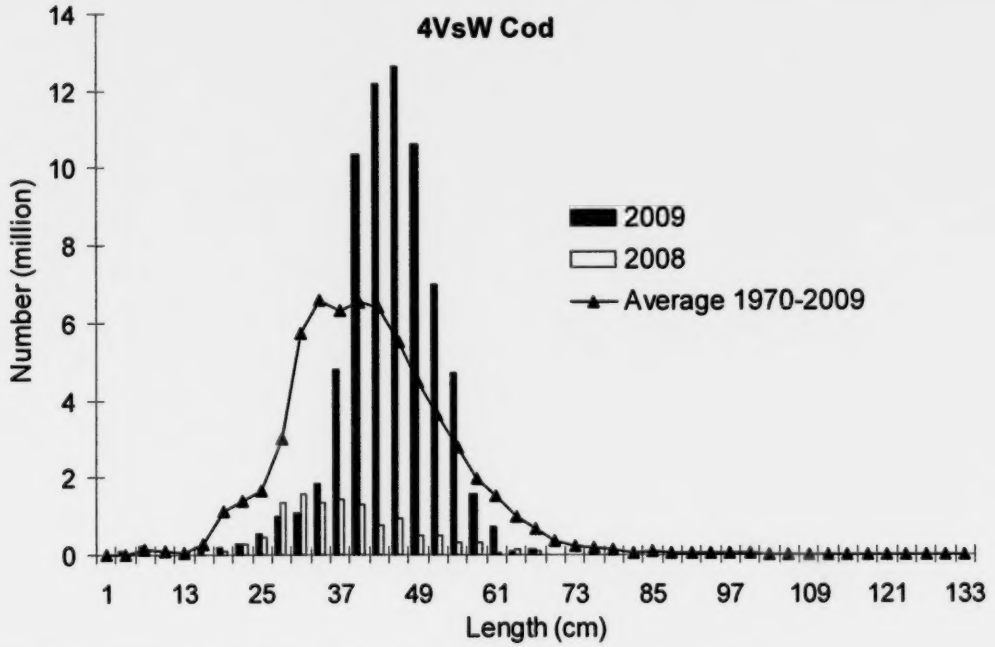

Figure 4d. Length composition for cod in 4VsW from the summer RV survey.

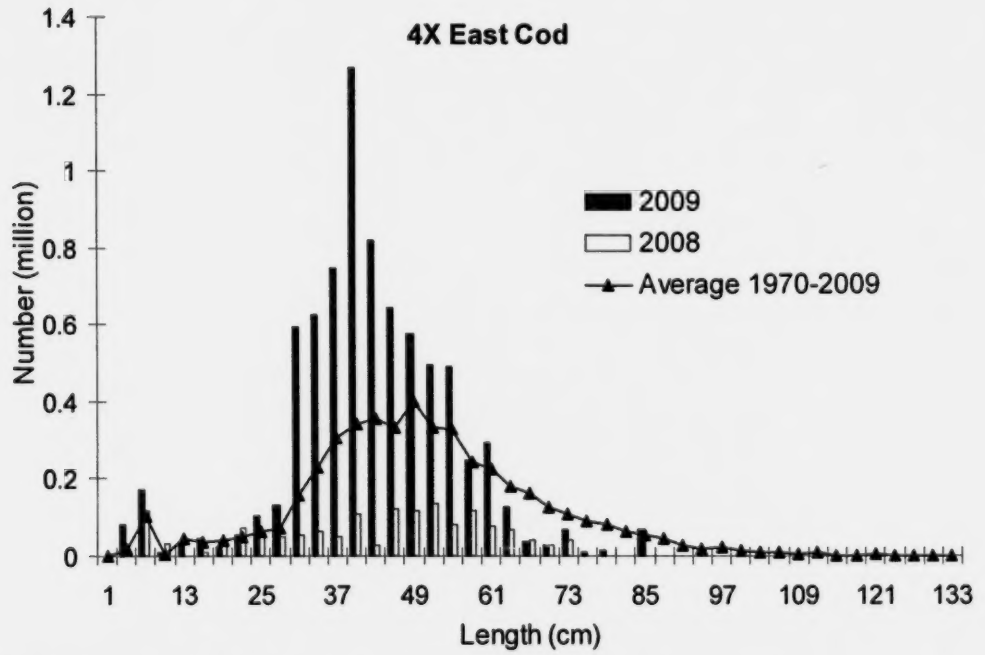

Figure 4e. Length composition for cod in 4X East from the summer RV survey.

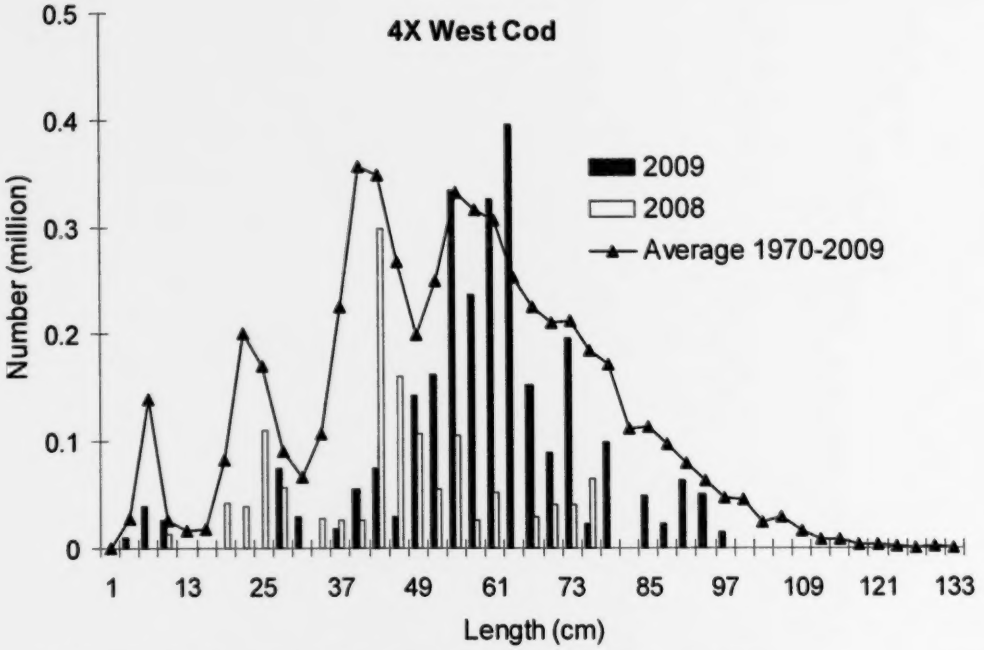

Figure 4f. Length composition for cod in 4X West from the summer RV survey.

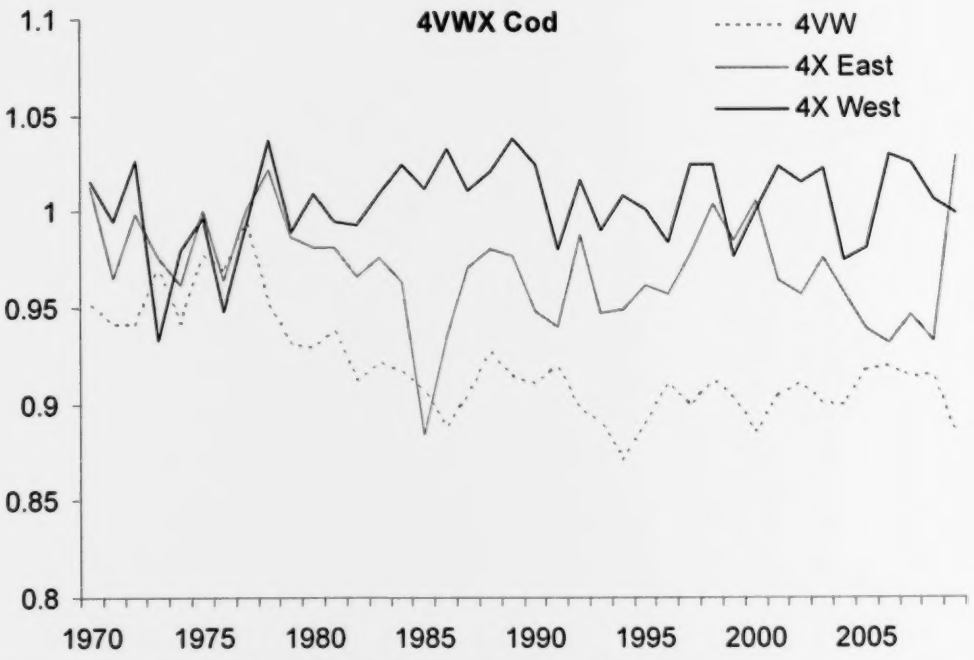

Figure 4g. Condition factor (Fulton's K) for cod from the summer RV survey.

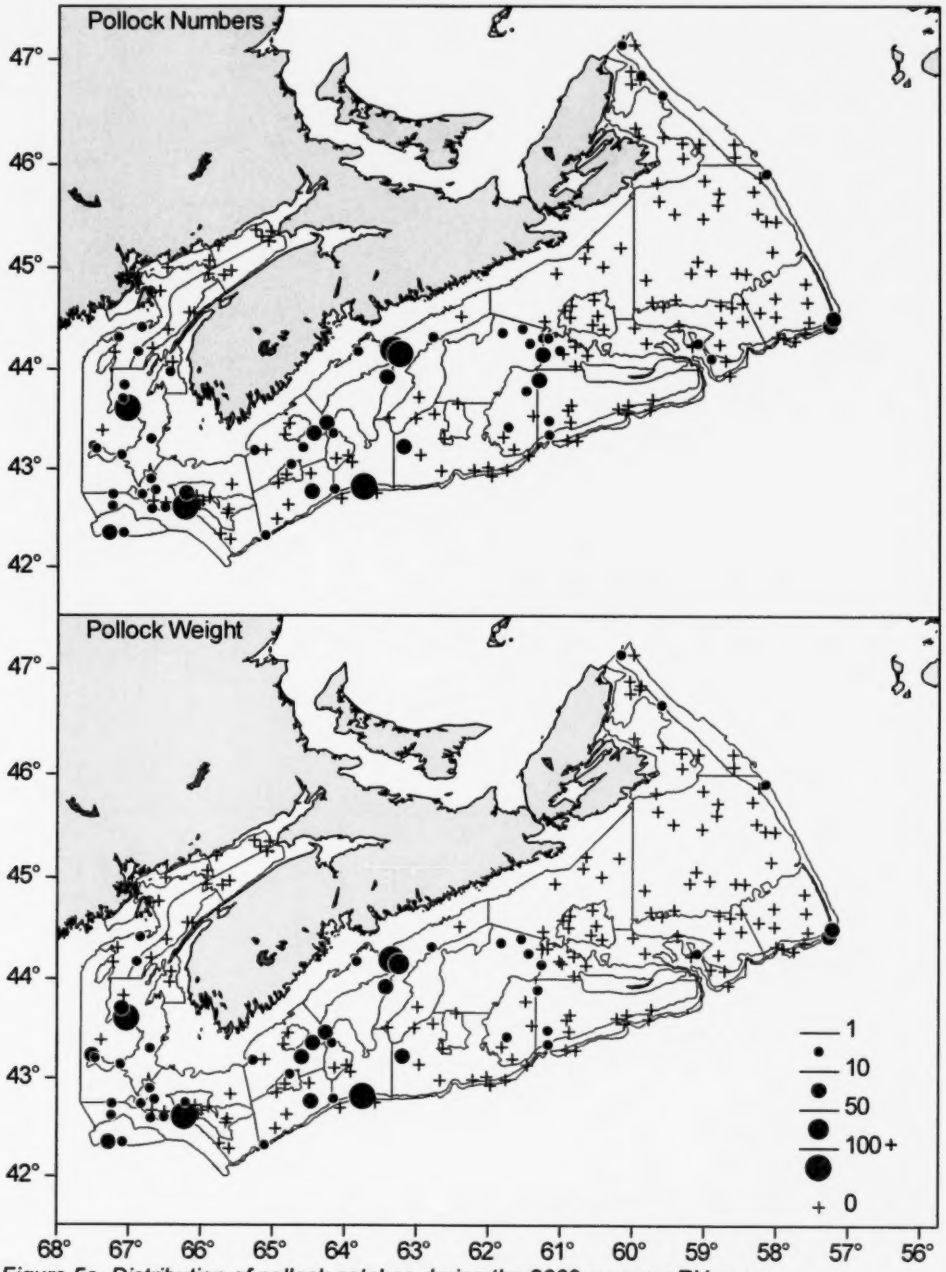

Figure 5a. Distribution of pollock catches during the 2009 summer RV survey.

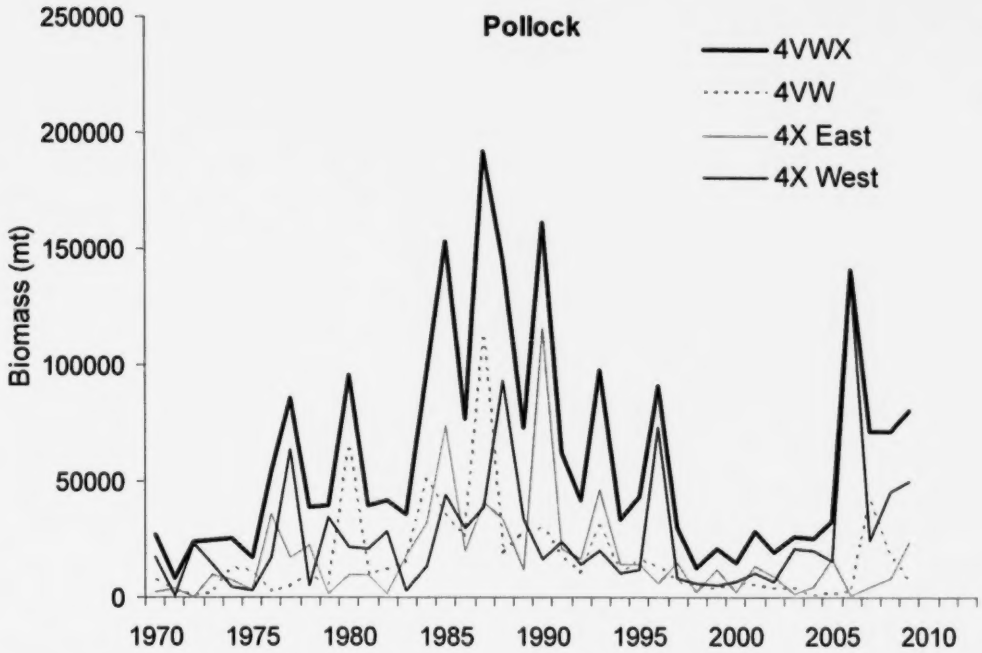

Figure 5b. Biomass estimate for pollock from the summer RV survey.

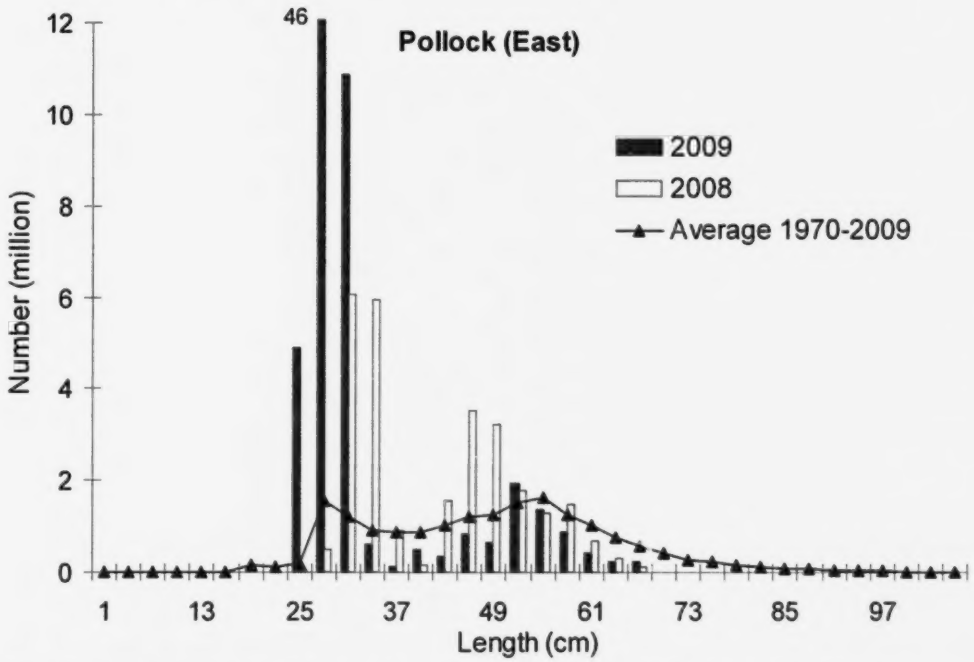

Figure 5c. Length composition for pollock eastern component from the summer RV survey.

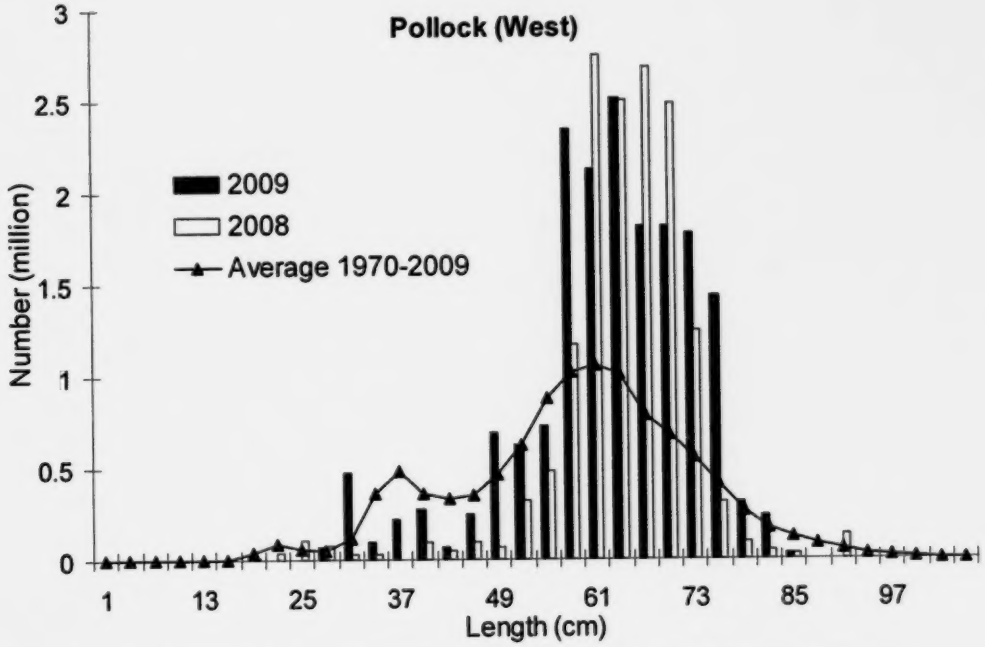

Figure 5d. Length composition for pollock western component from the summer RV survey.

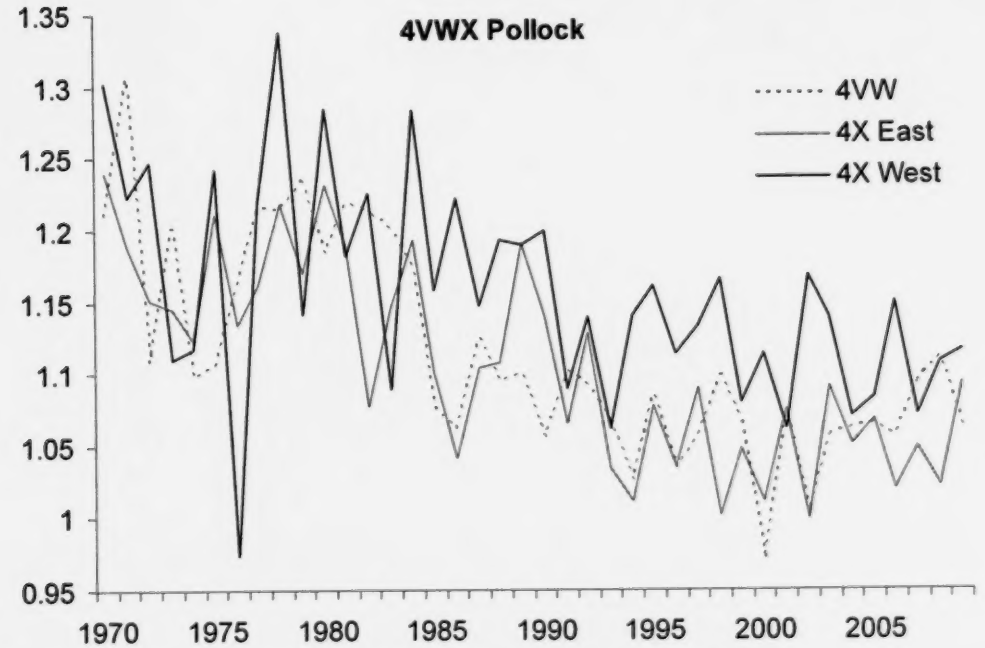

Figure 5e. Condition factor (Fulton's K) for pollock from the summer RV survey.

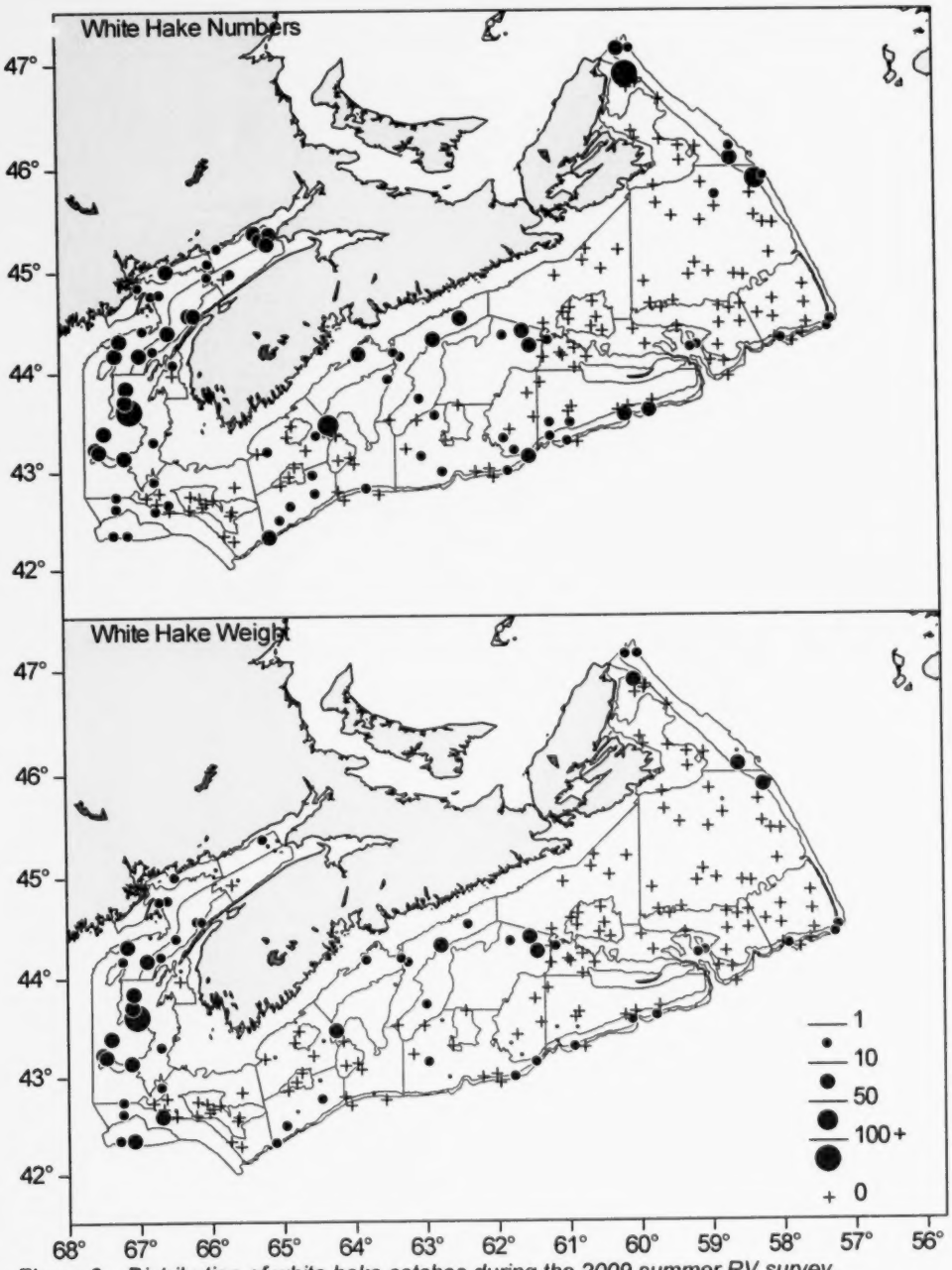

Figure 6a. Distribution of white hake catches during the 2009 summer RV survey.

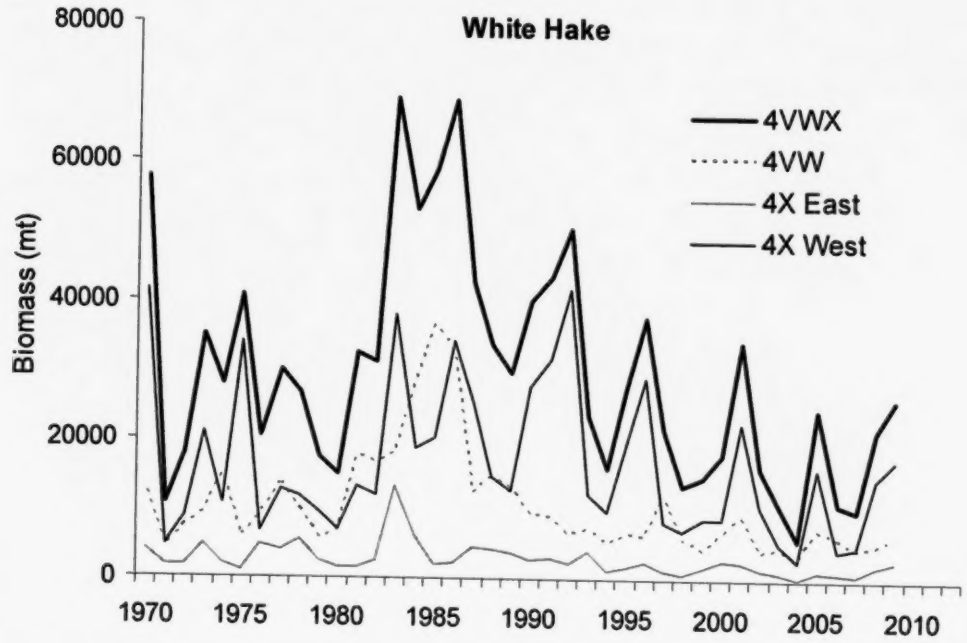

Figure 6b. Biomass estimate for white hake from the summer RV survey.

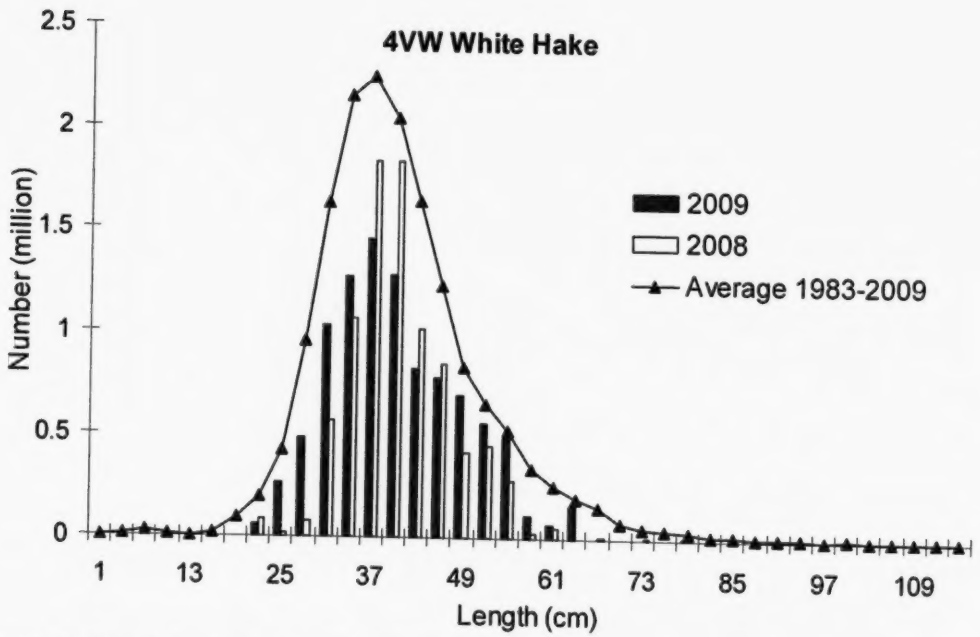

Figure 6c. Length composition for white hake in 4VW from the summer RV survey.

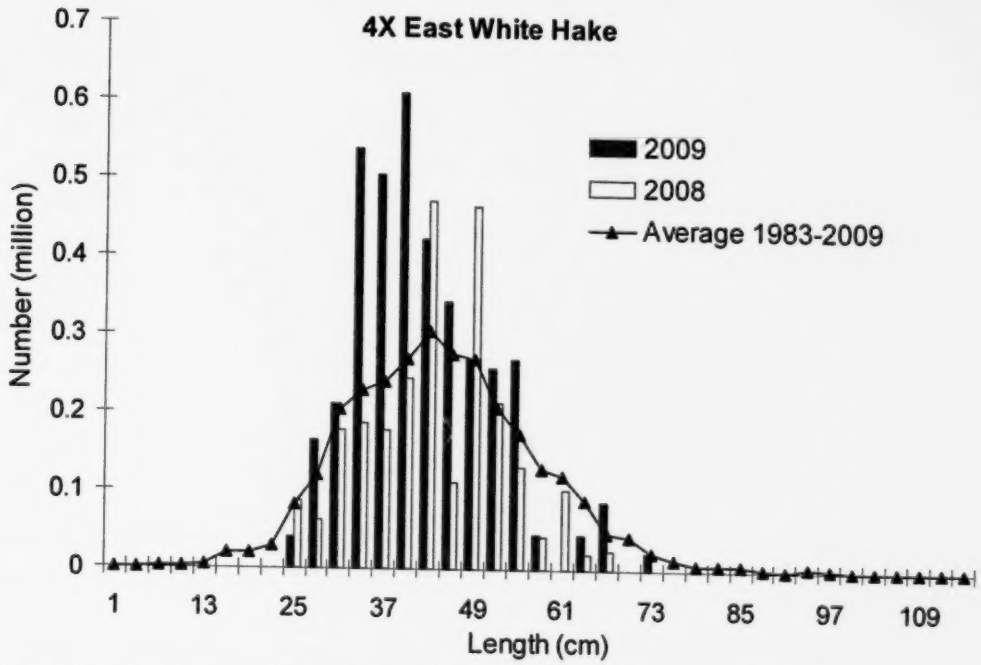

Figure 6d. Length composition for white hake in 4X East from the summer RV survey.

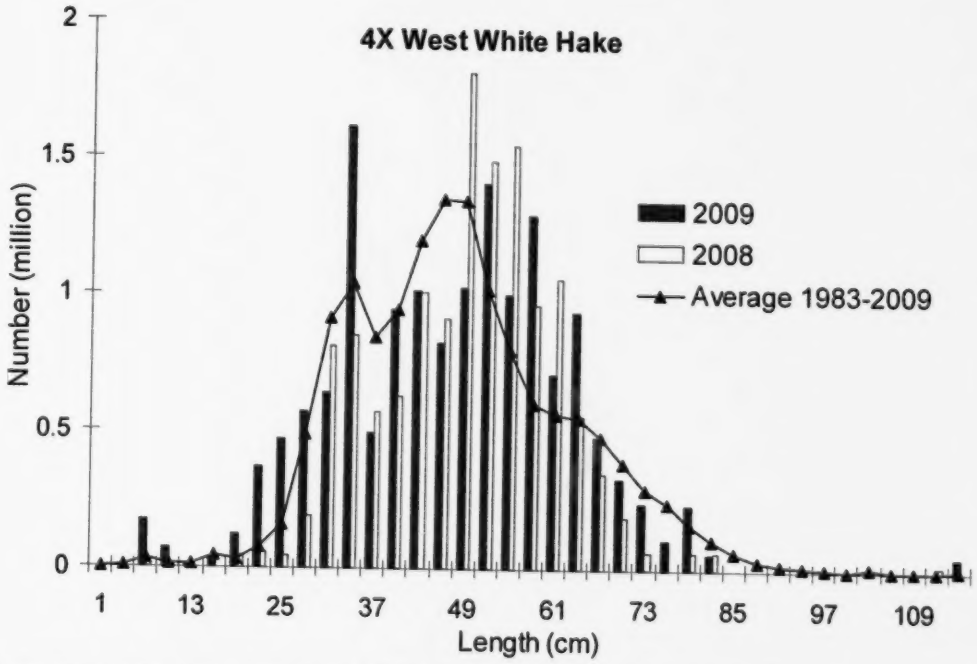

Figure 6e. Length composition for white hake in 4X West from the summer RV survey.

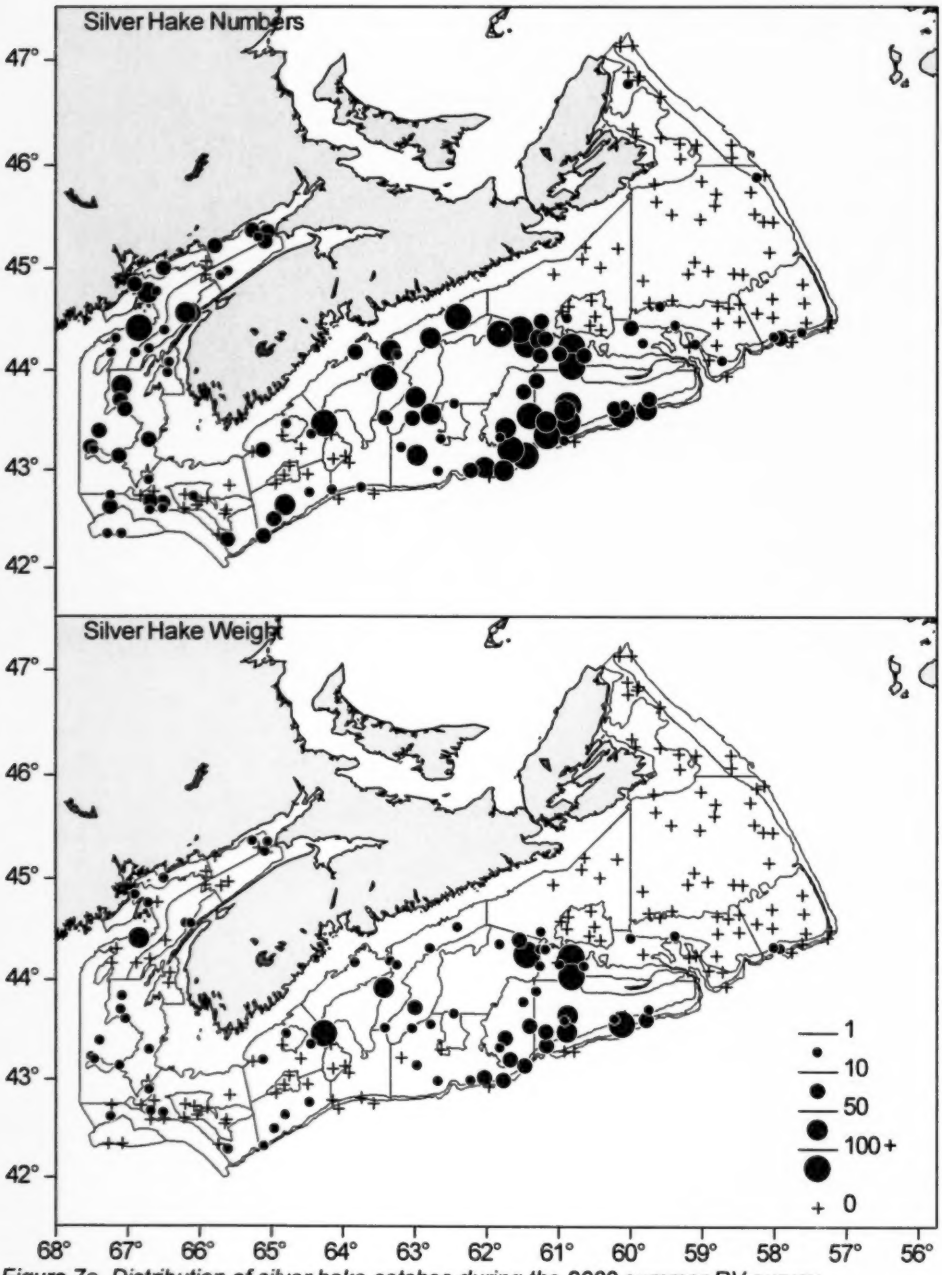

Figure 7a. Distribution of silver hake catches during the 2009 summer RV survey.

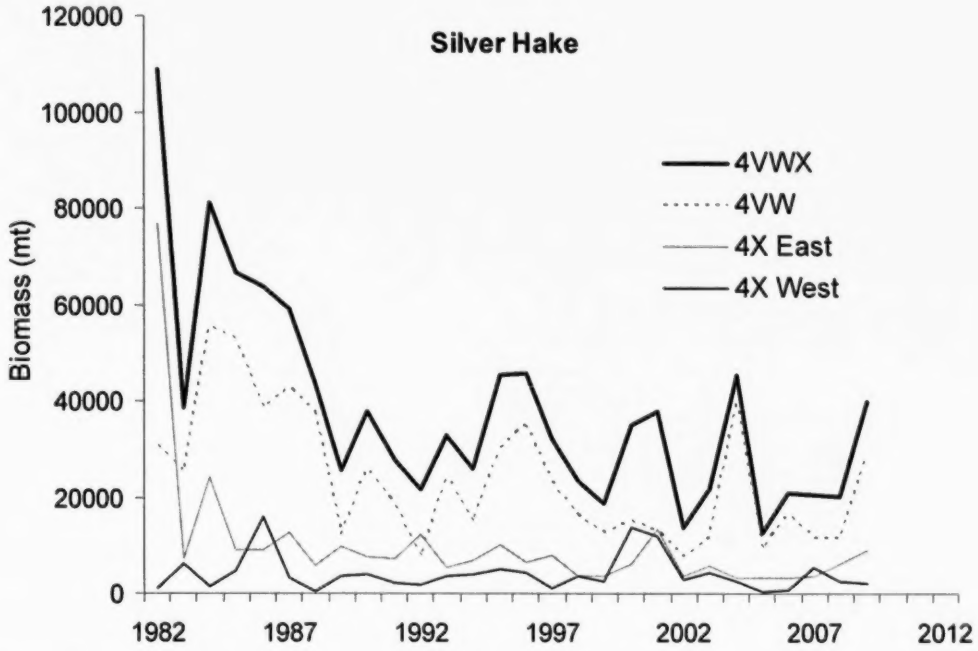

Figure 7b. Biomass estimate for silver hake from the summer RV survey.

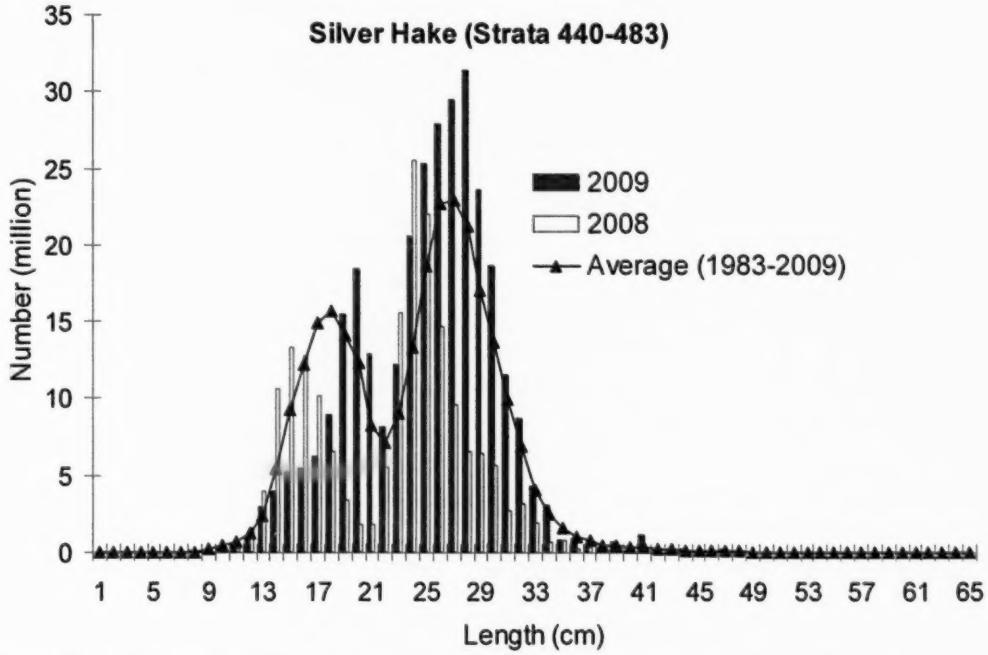

Figure 7c. Length composition for silver hake in strata 440-483 from the summer RV survey.

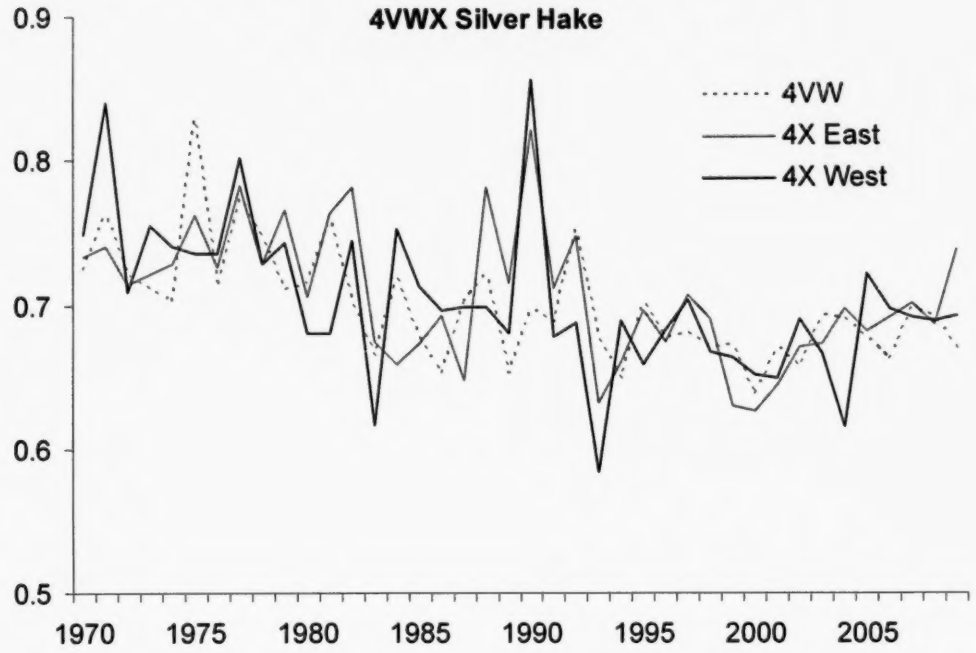

Figure 7d. Condition factor (Fulton's K) for silver hake from the summer RV survey.

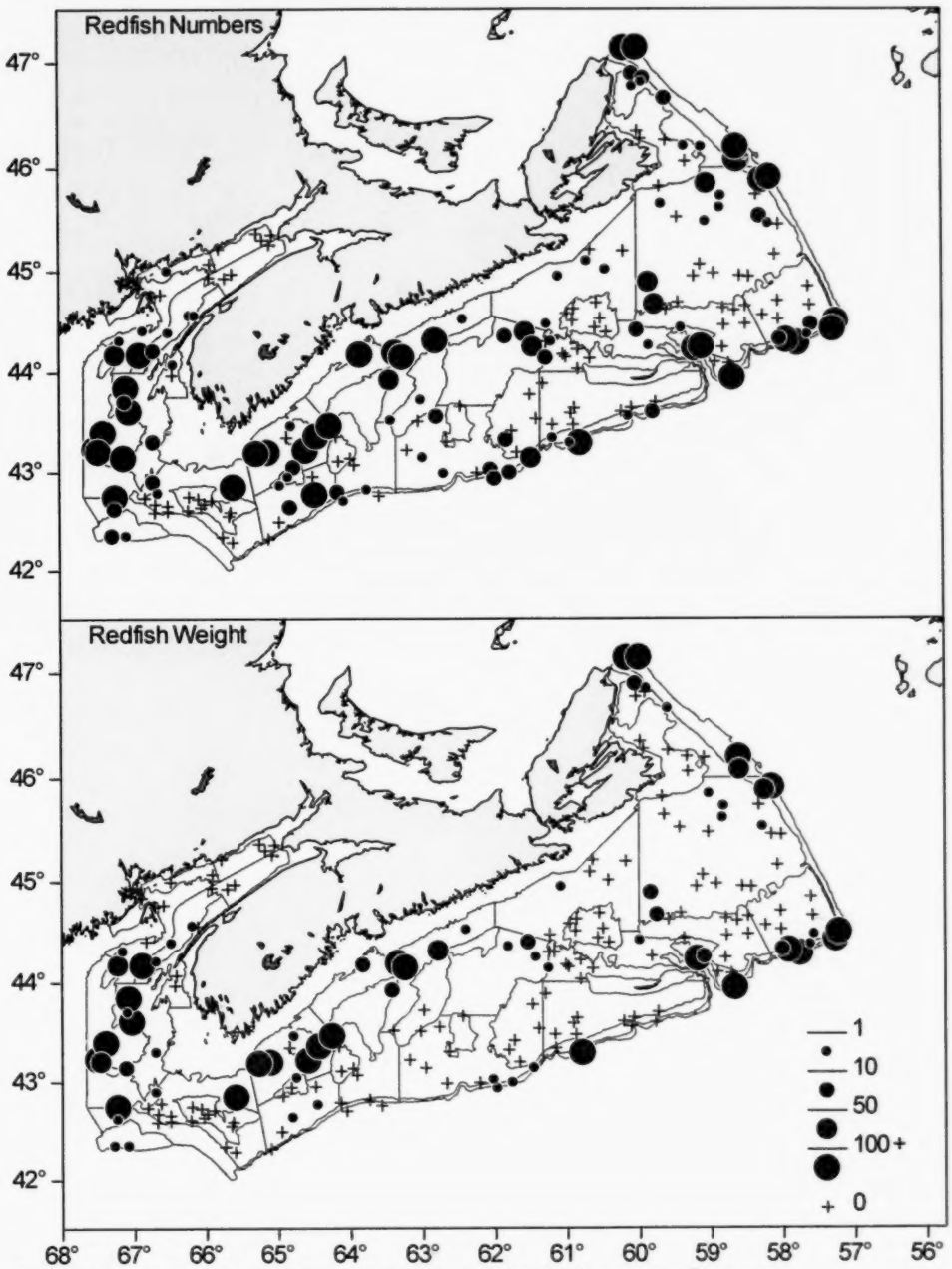

Figure 8a. Distribution of redfish catches during the 2009 summer RV survey.

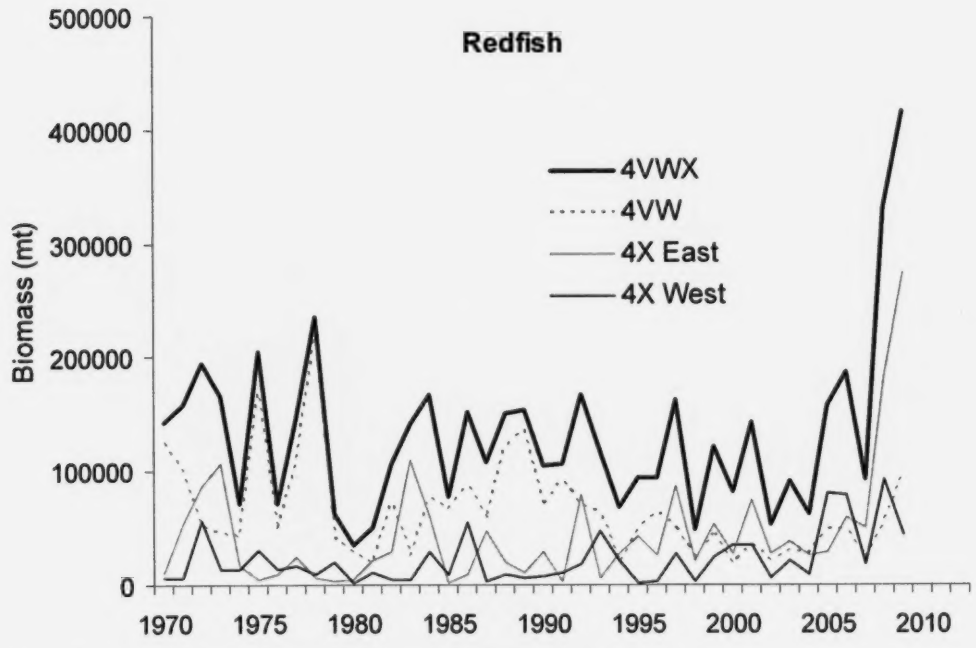

Figure 8b. Biomass estimate for redfish from the summer RV survey.

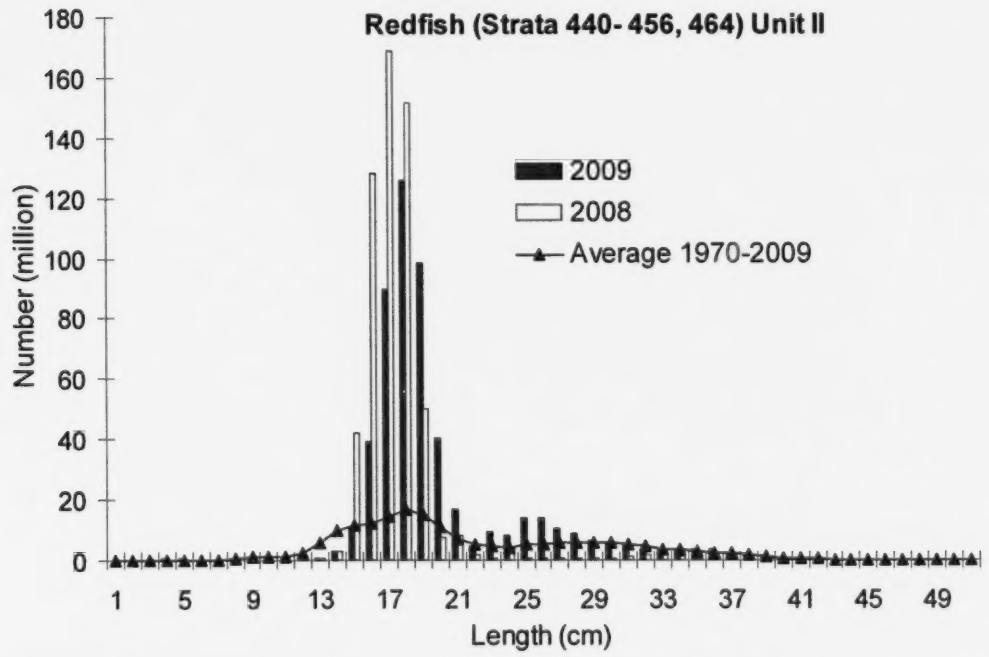

Figure 8c. Length composition of redfish in Unit II from the summer RV survey.

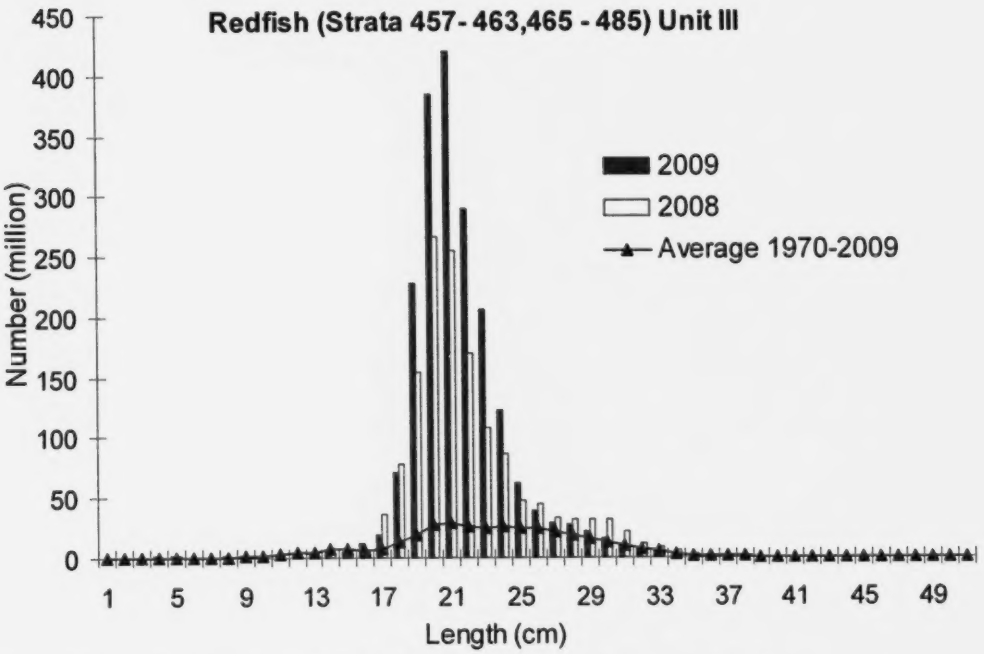

Figure 8d. Length composition of redfish in Unit III from the summer RV survey.

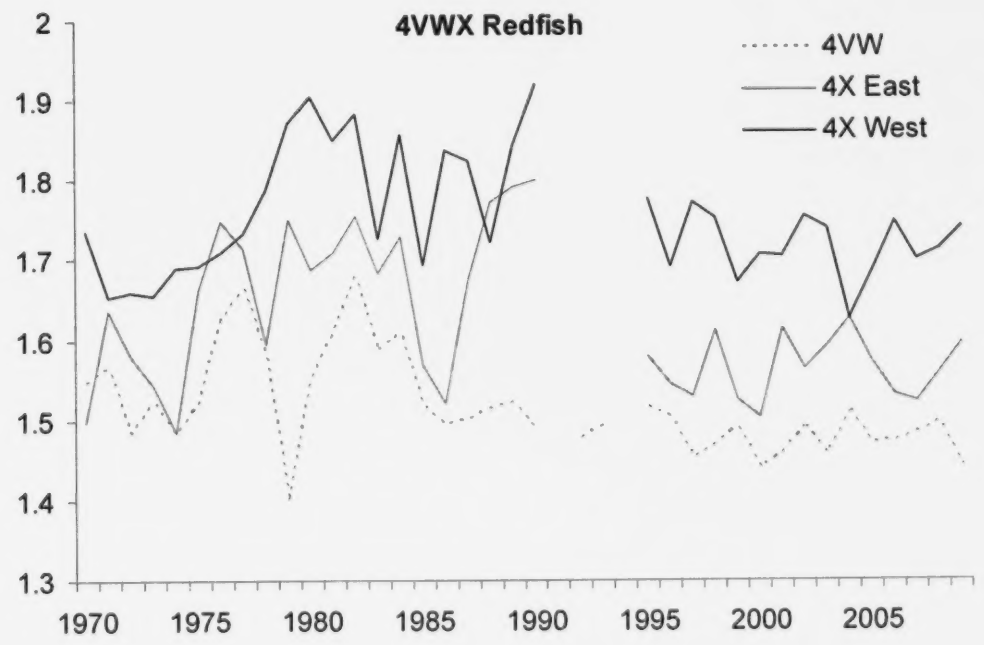

Figure 8e. Condition factor (Fulton's K) for redfish from the summer RV survey.

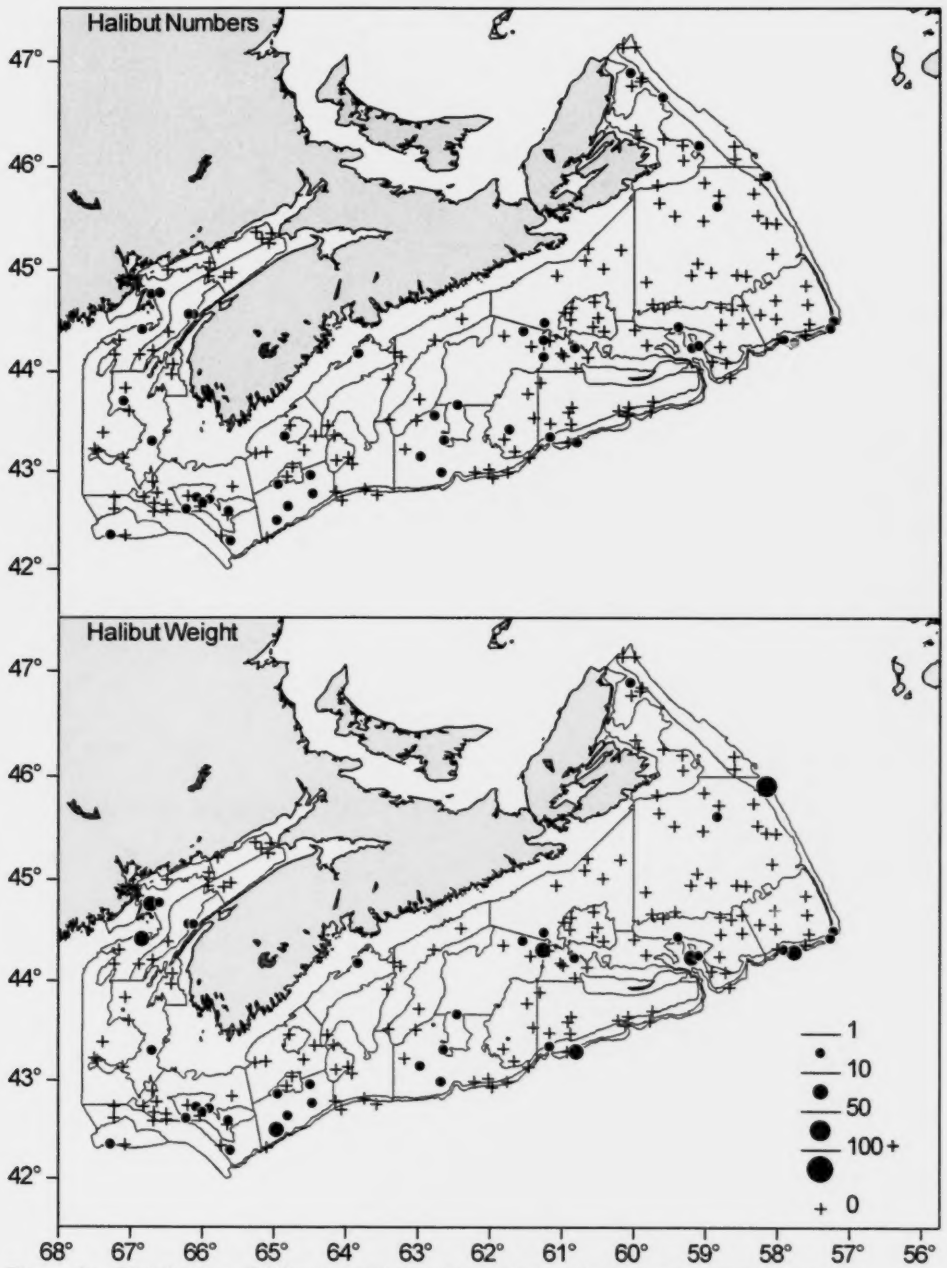

Figure 9a. Distribution of Atlantic halibut catches during the 2009 summer RV survey.

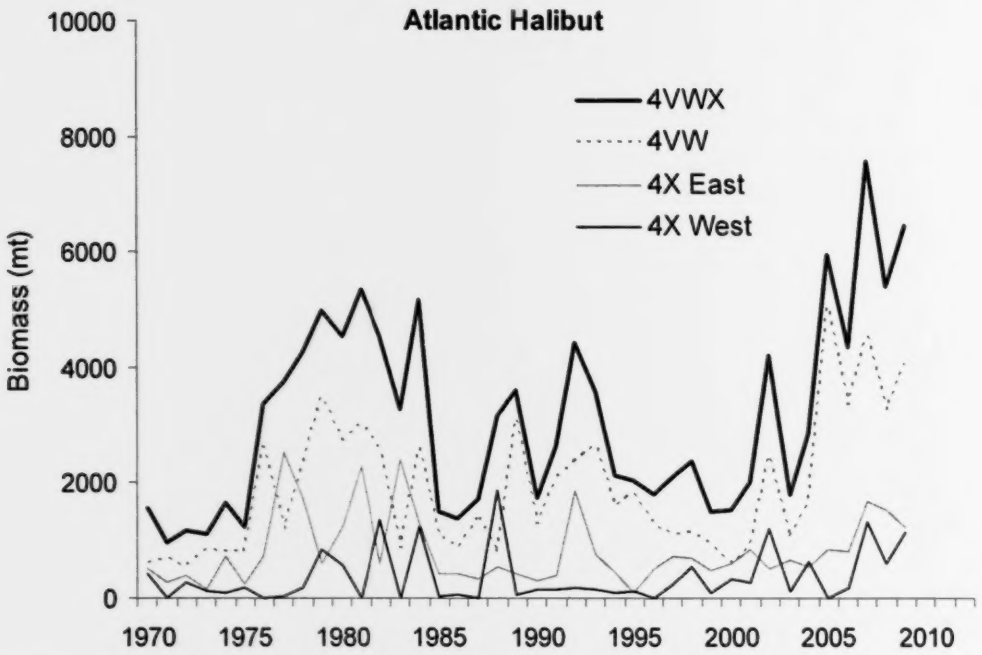

Figure 9b. Biomass estimate for Atlantic halibut from the summer RV survey.

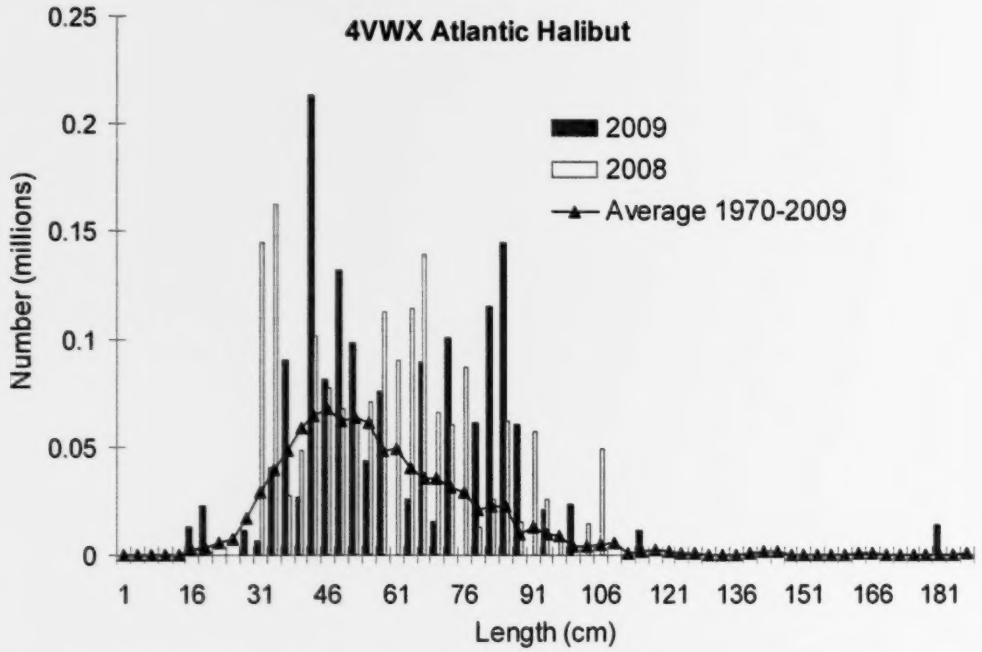

Figure 9c. Length composition for Atlantic halibut in 4VWX from the summer RV survey.

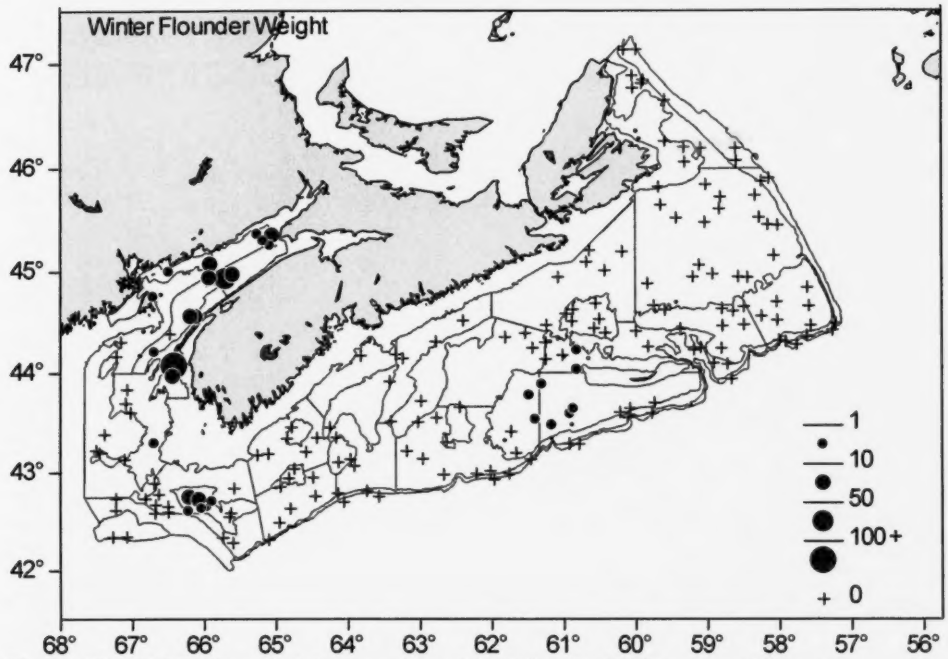

Figure 10a. Distribution of winter flounder catch during the 2009 summer RV survey.

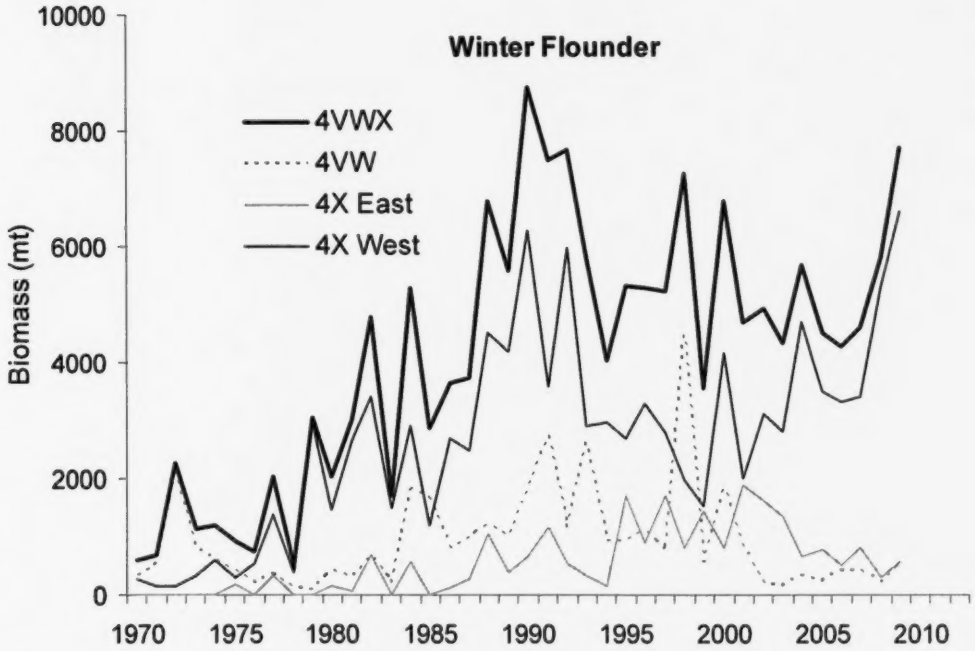

Figure 10b. Biomass estimate for winter flounder from the summer RV survey.

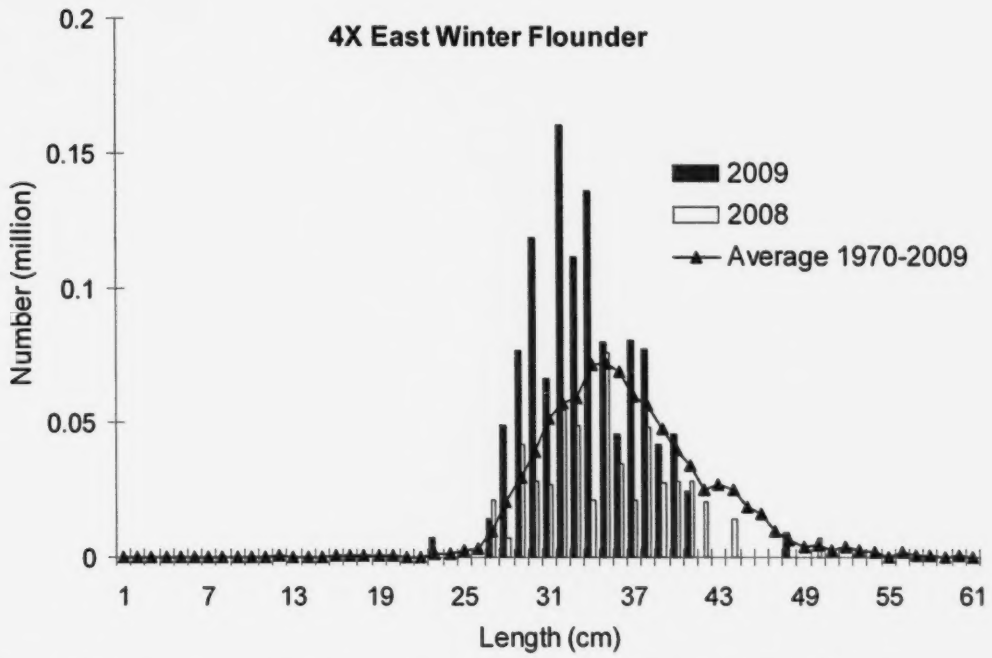

Figure 10c. Length composition for winter flounder in 4X East from the summer RV survey.

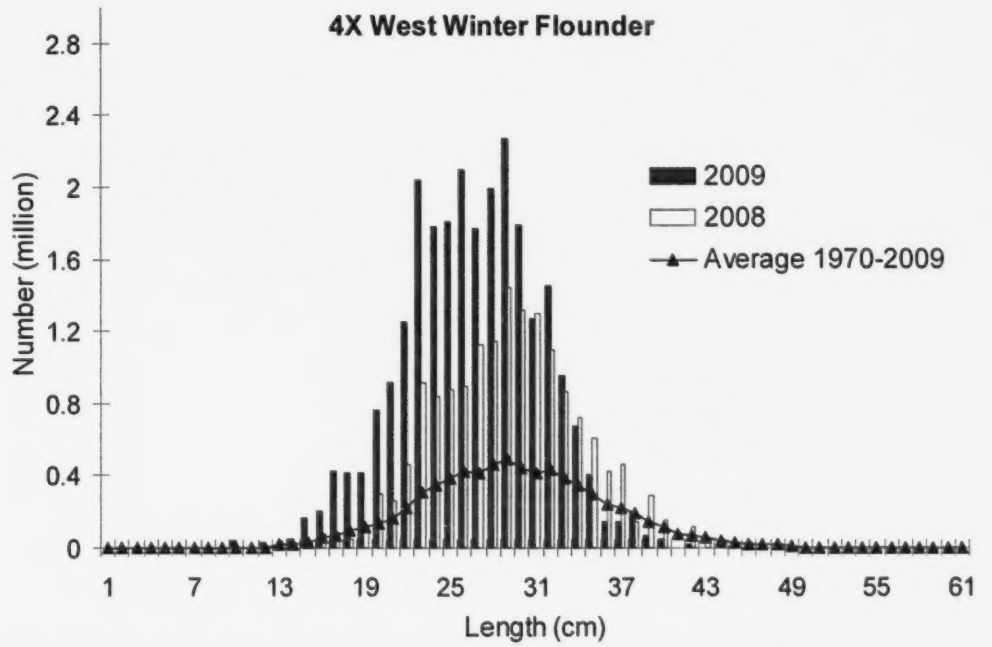

Figure 10d. Length composition for winter flounder in 4X West from the summer RV survey.

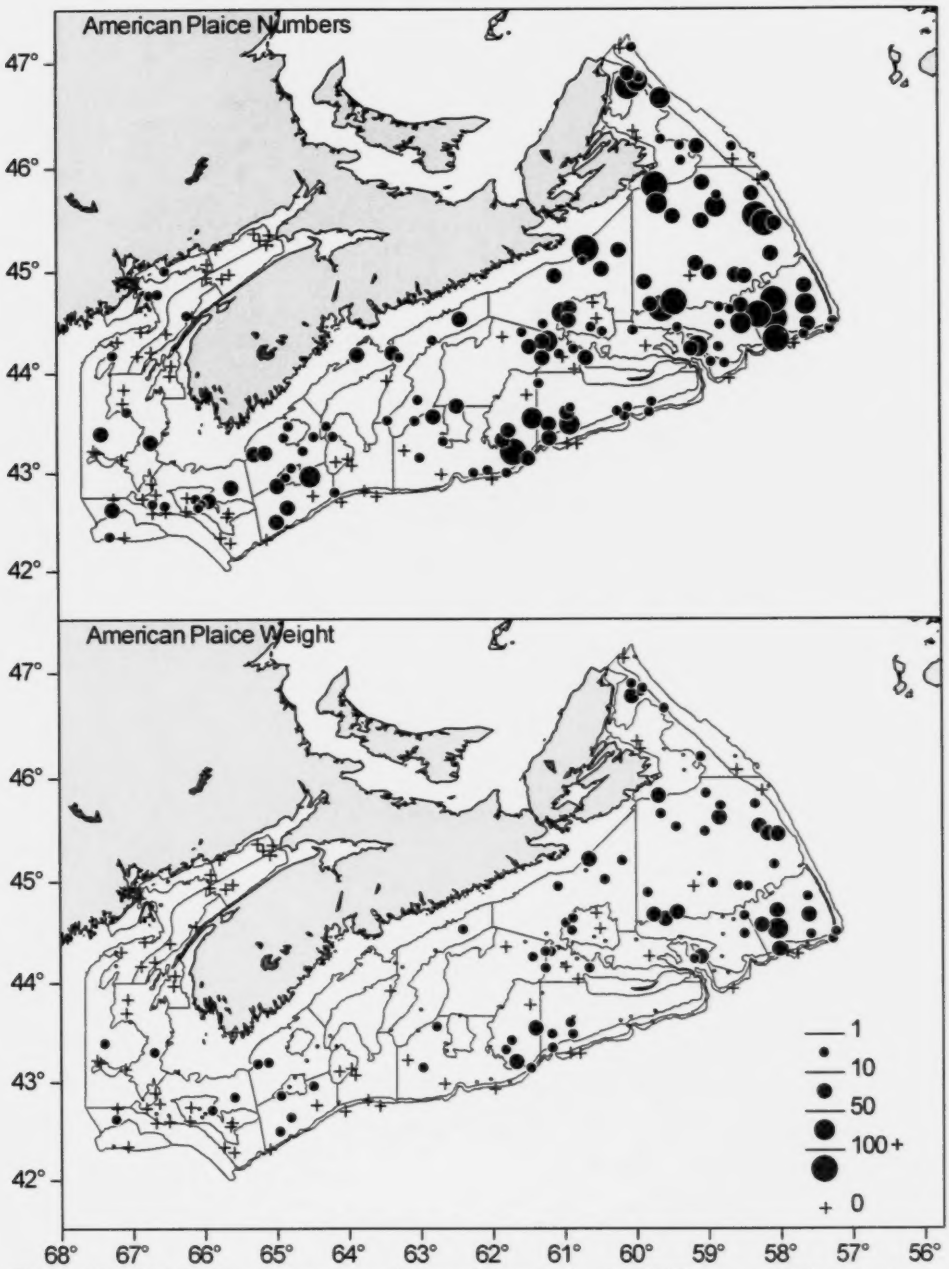

Figure 11a. Distribution of American plaice catches during the 2009 summer RV survey.

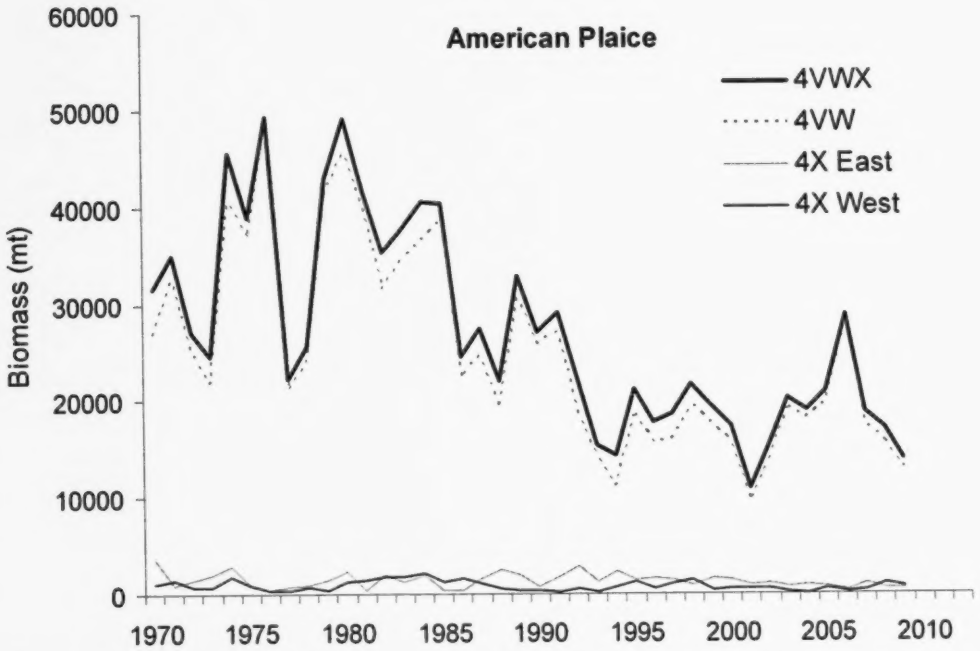

Figure 11b. Biomass estimate for American plaice from the summer RV survey.

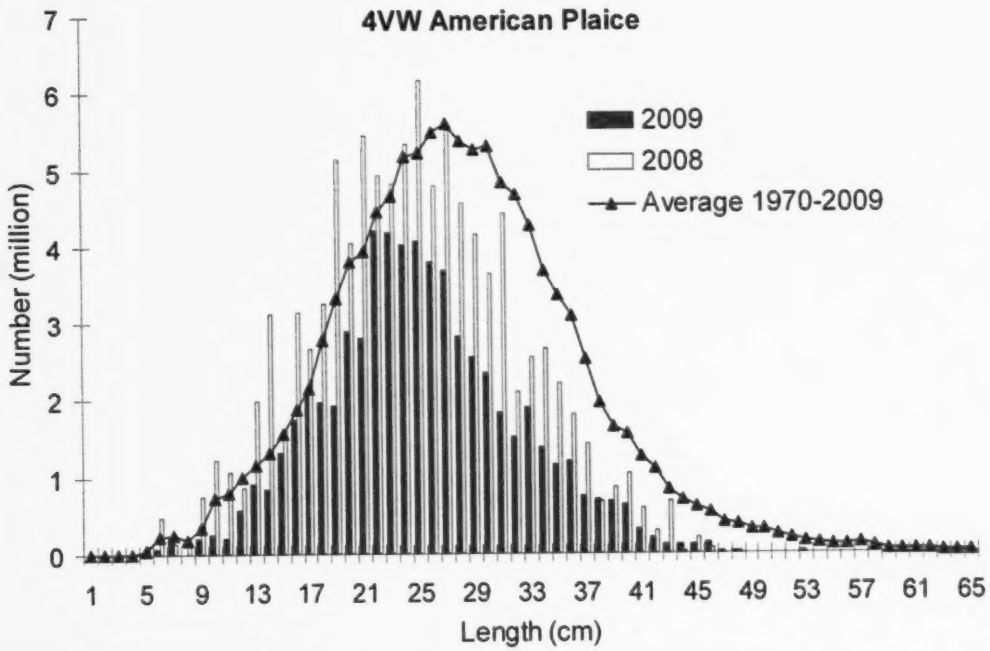

Figure 11c. Length composition for American plaice in 4VW from the summer RV survey.

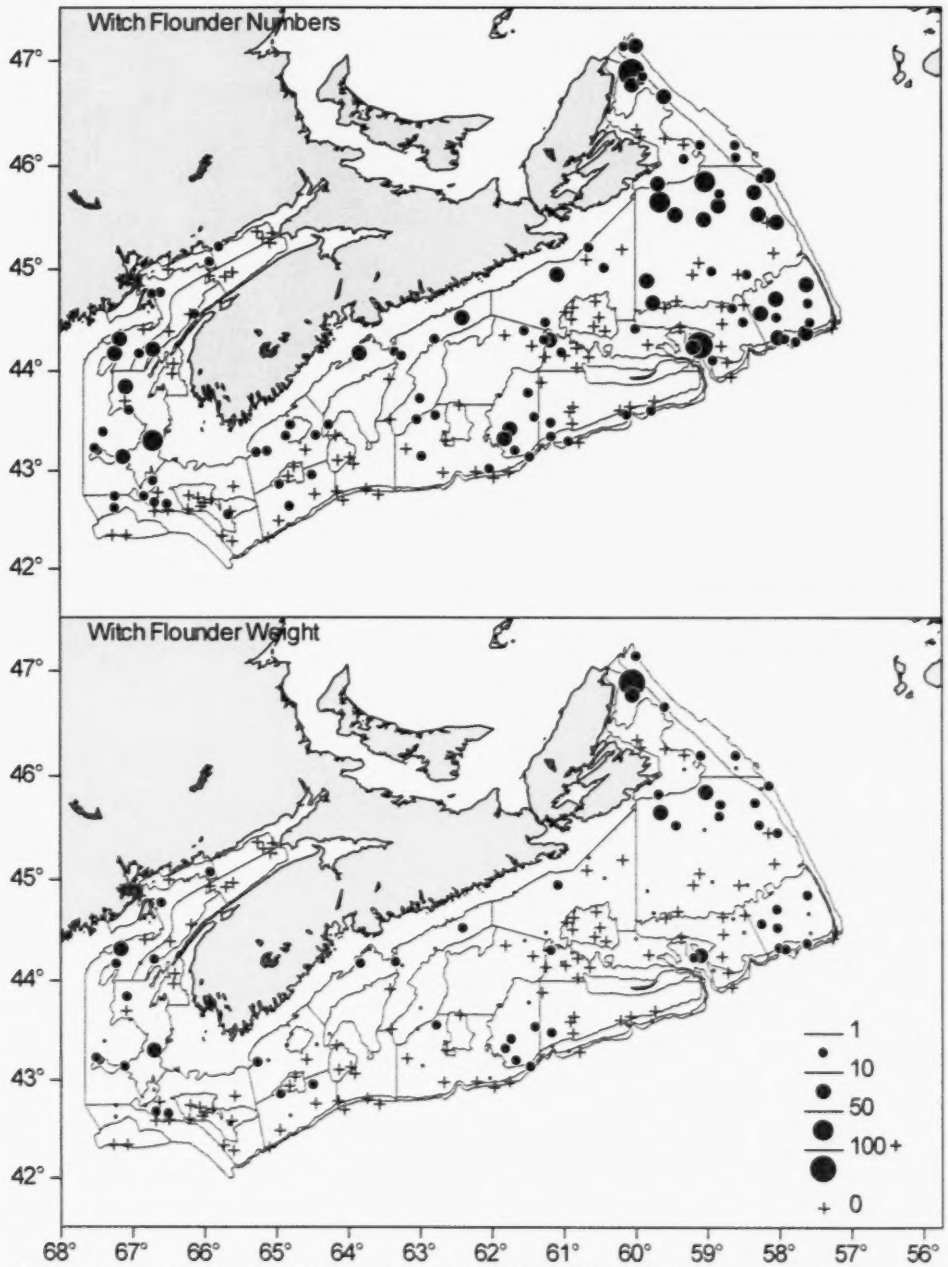

Figure 12a. Distribution of witch flounder catches during the 2009 summer RV survey.

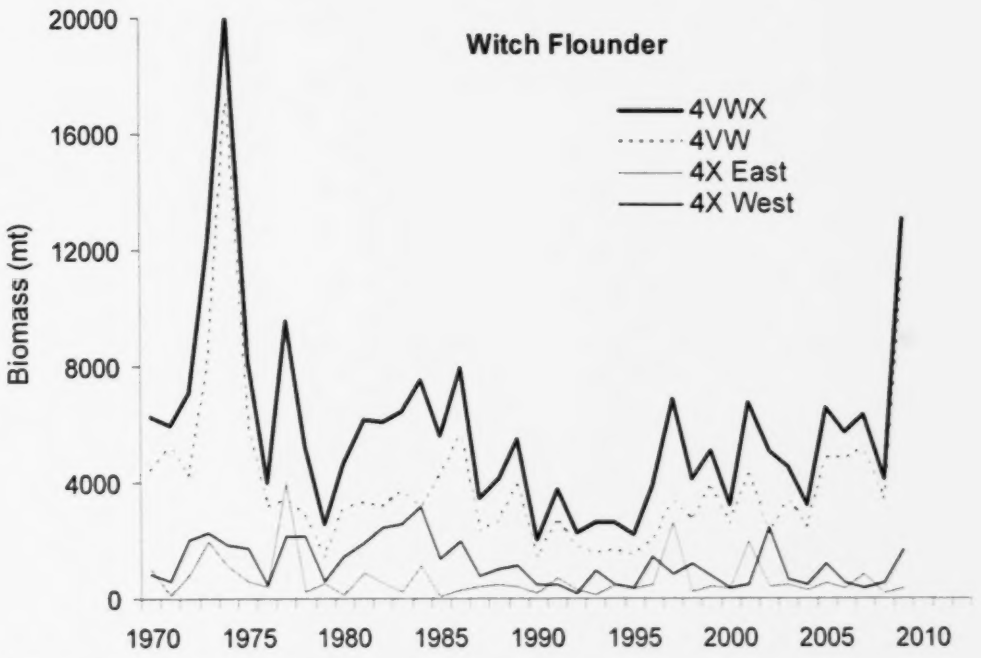

Figure 12b. Biomass estimate for witch flounder from the summer RV survey.

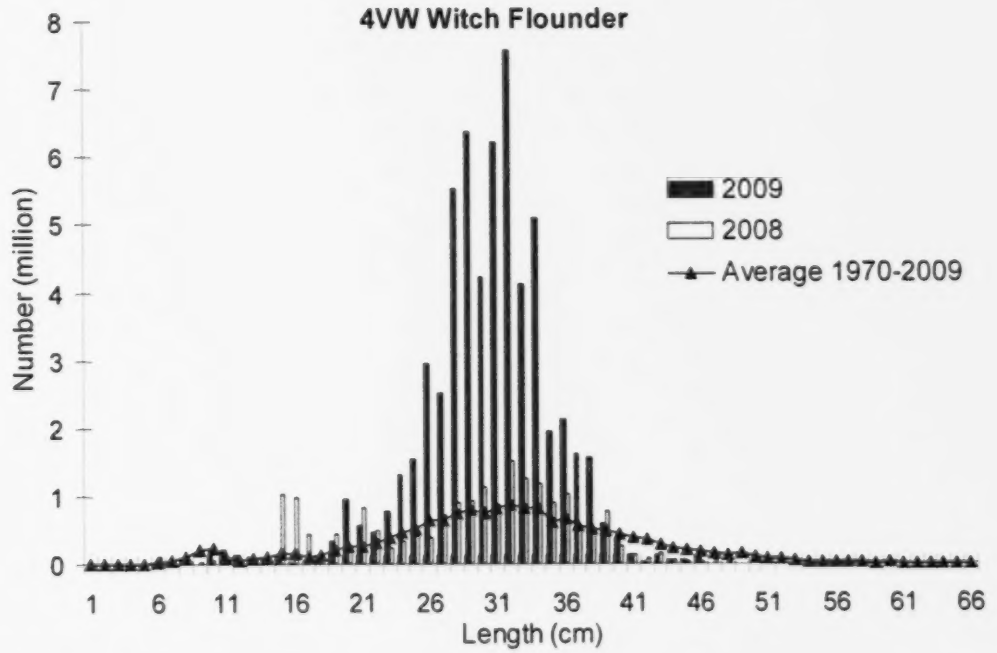

Figure 12c. Length composition for witch flounder in 4VW from the summer RV survey.

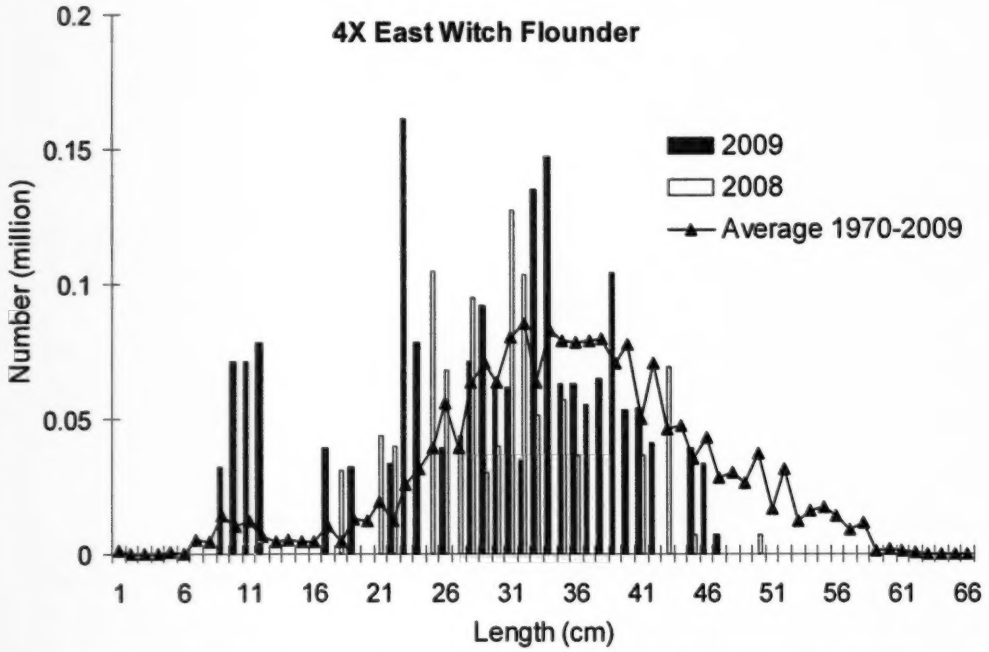

Figure 12d. Length composition for witch flounder in 4X East from the summer RV survey.

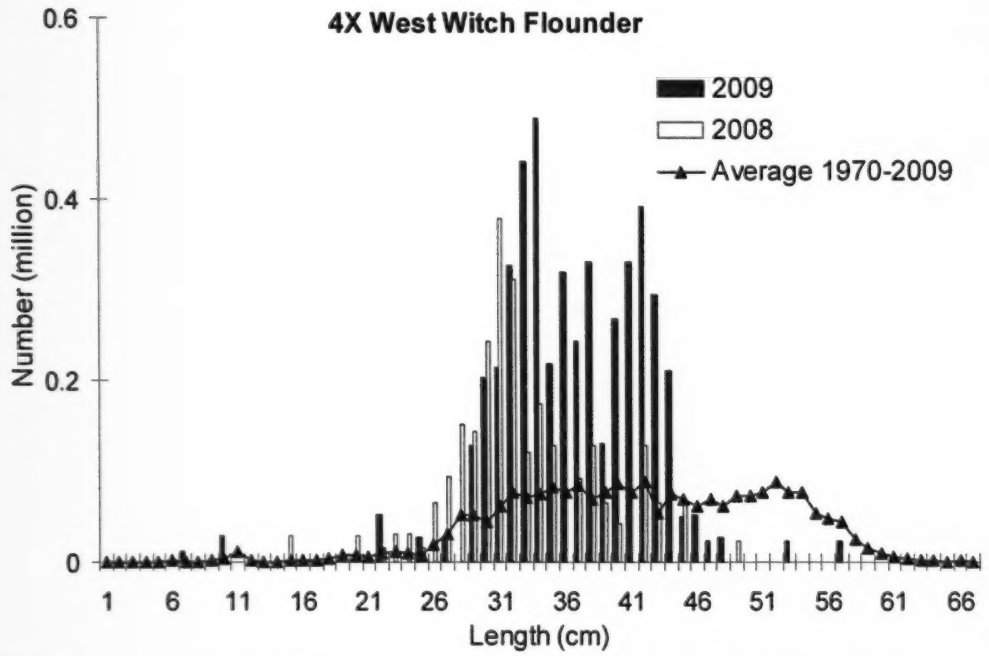

Figure 12e. Length composition for witch flounder in 4X West from the summer RV survey.

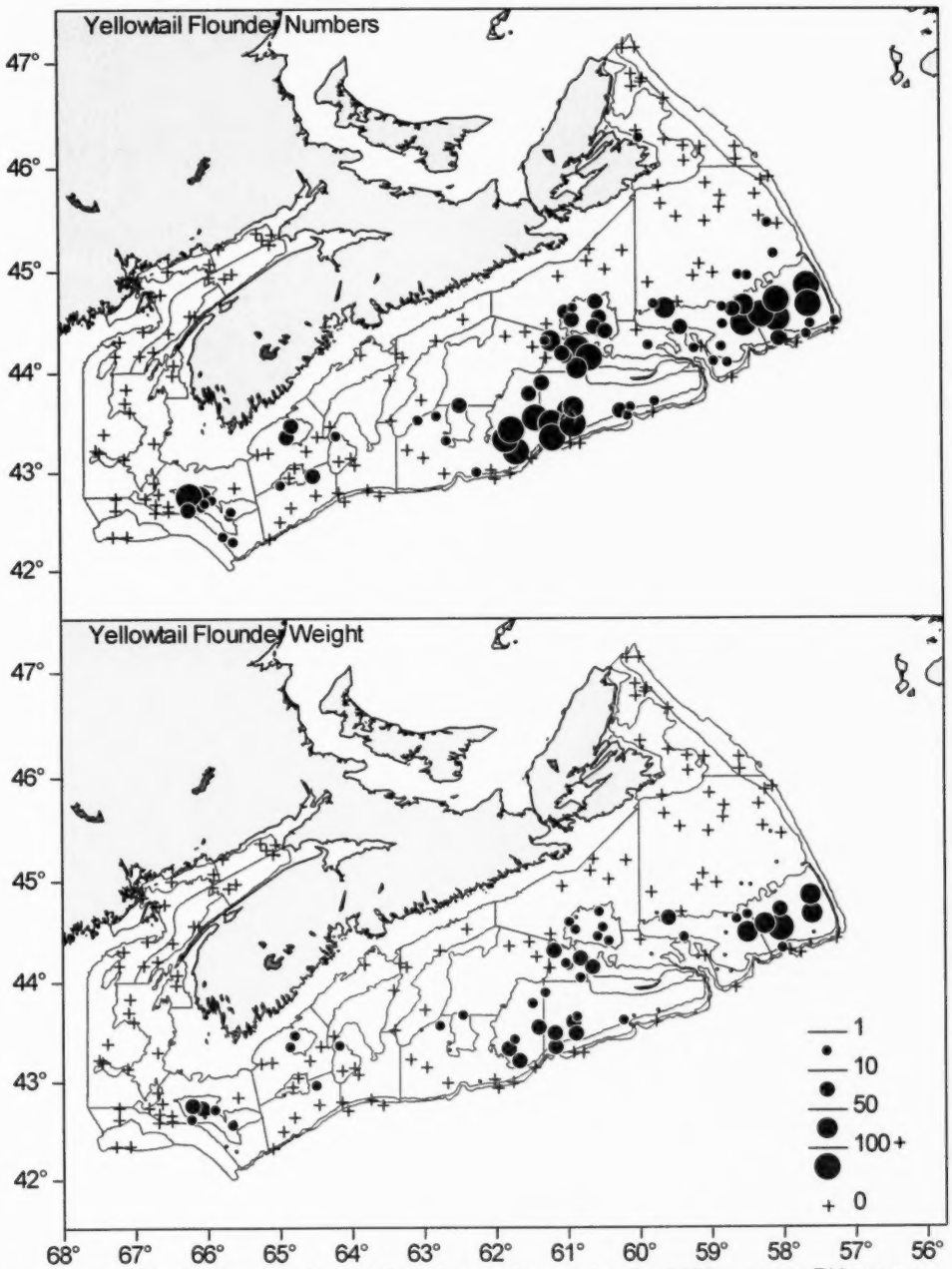

Figure 13a. Distribution of yellowtail flounder catches during the 2009 summer RV survey.

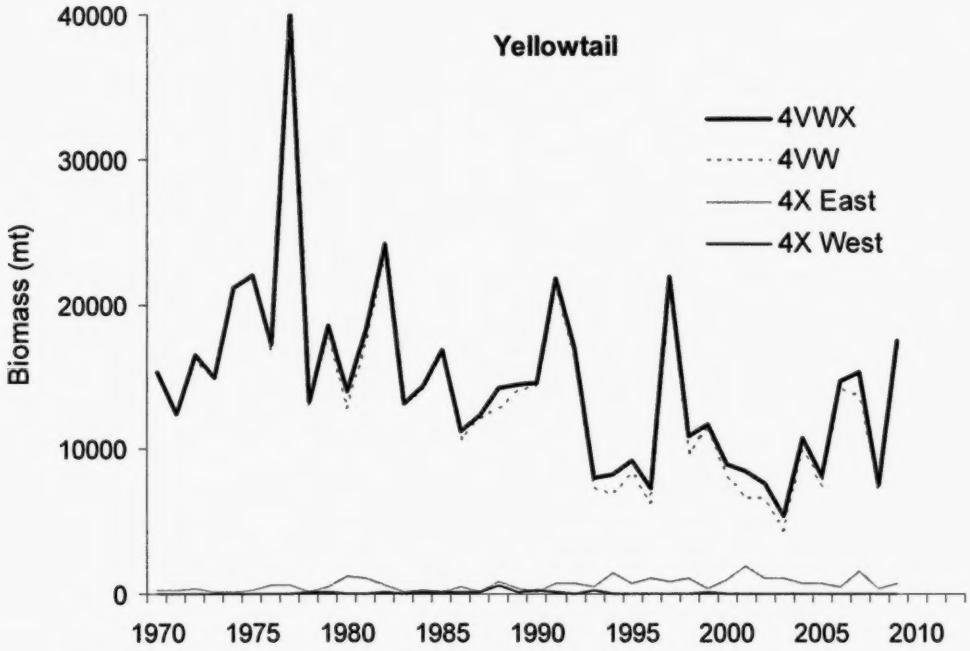

Figure 13b. Biomass estimate for yellowtail flounder from the summer RV survey.

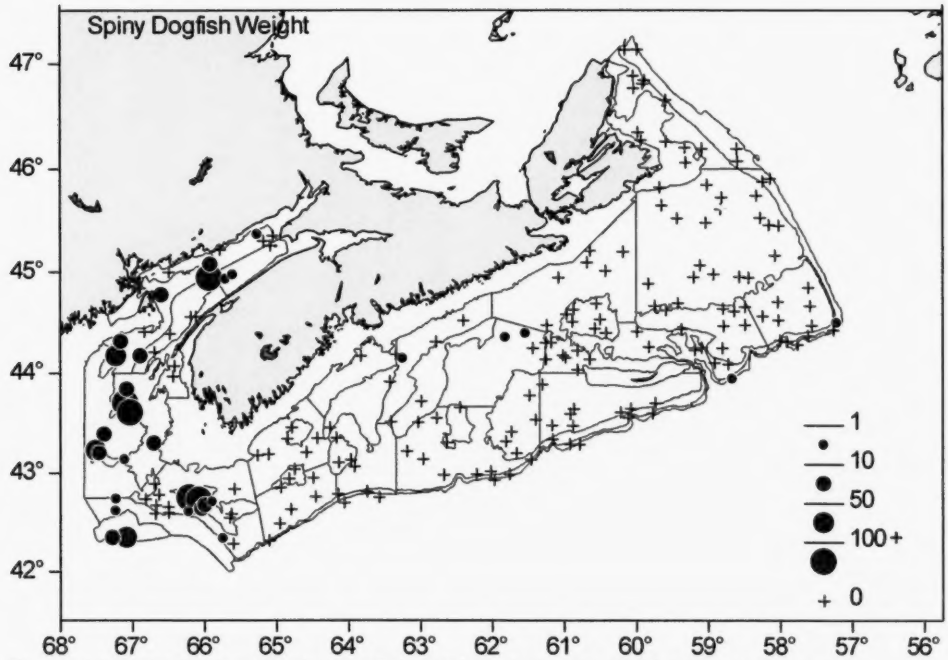

Figure 14a. Distribution of spiny dogfish catches during the 2009 summer RV survey.

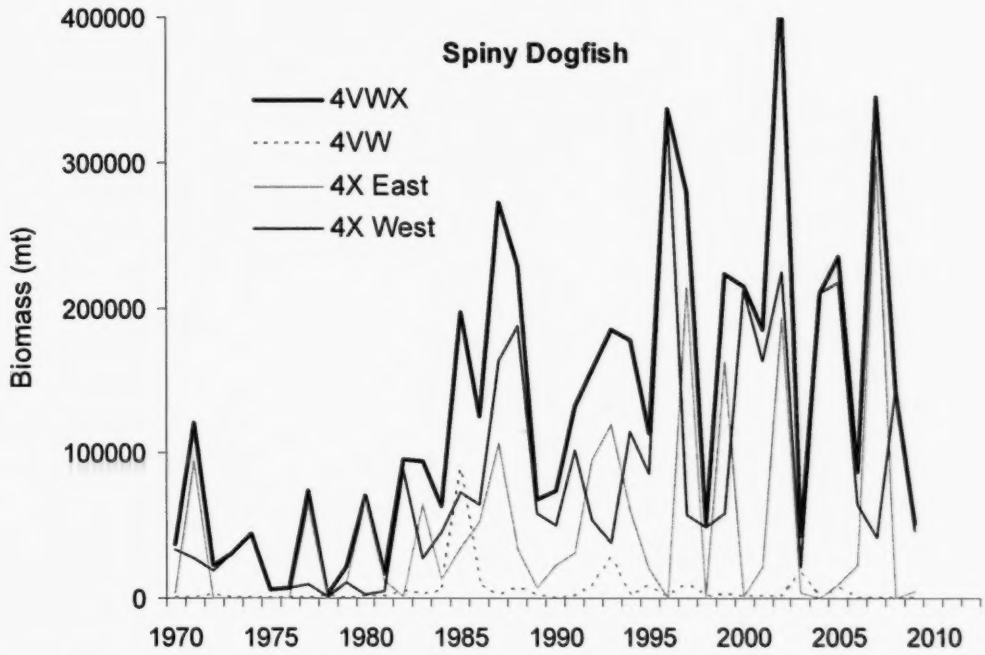

Figure 14b. Biomass estimate for spiny dogfish from the summer RV survey.

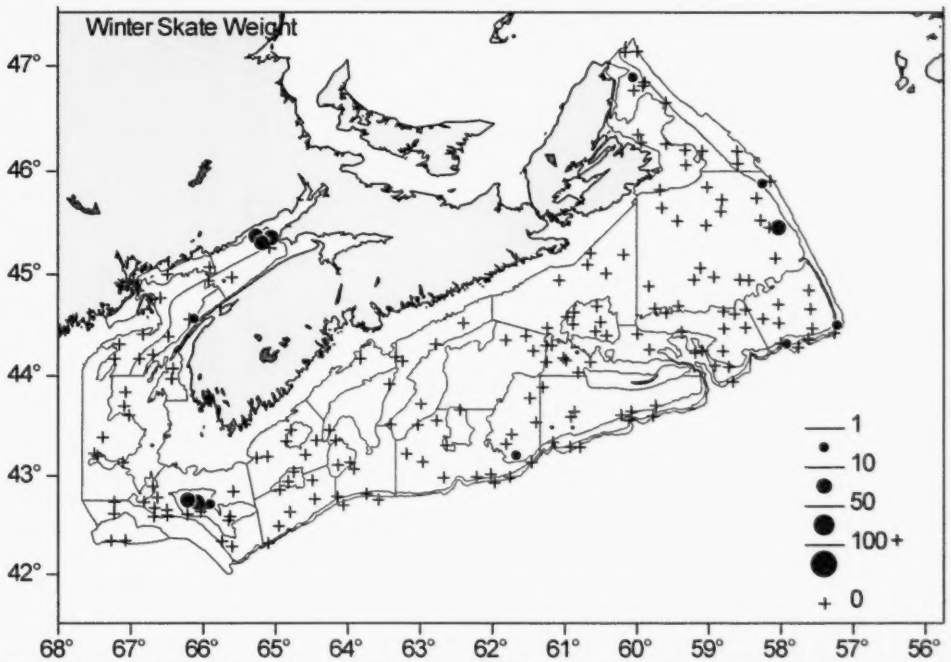

Figure 15a. Distribution of winter skate catches during the 2009 summer RV survey.

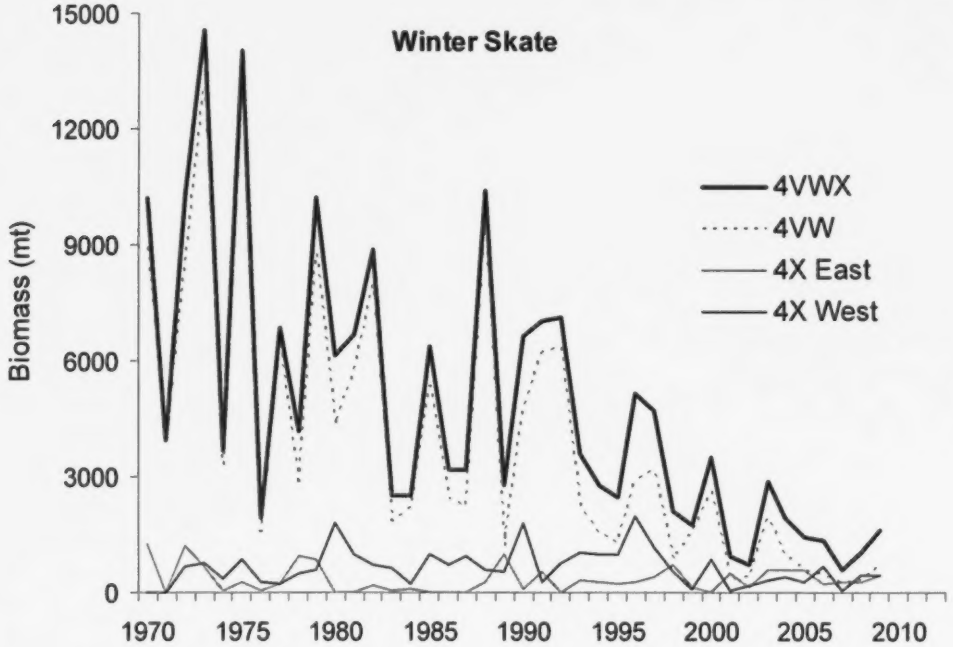

Figure 15b. Biomass estimate for winter skate from the summer RV survey.

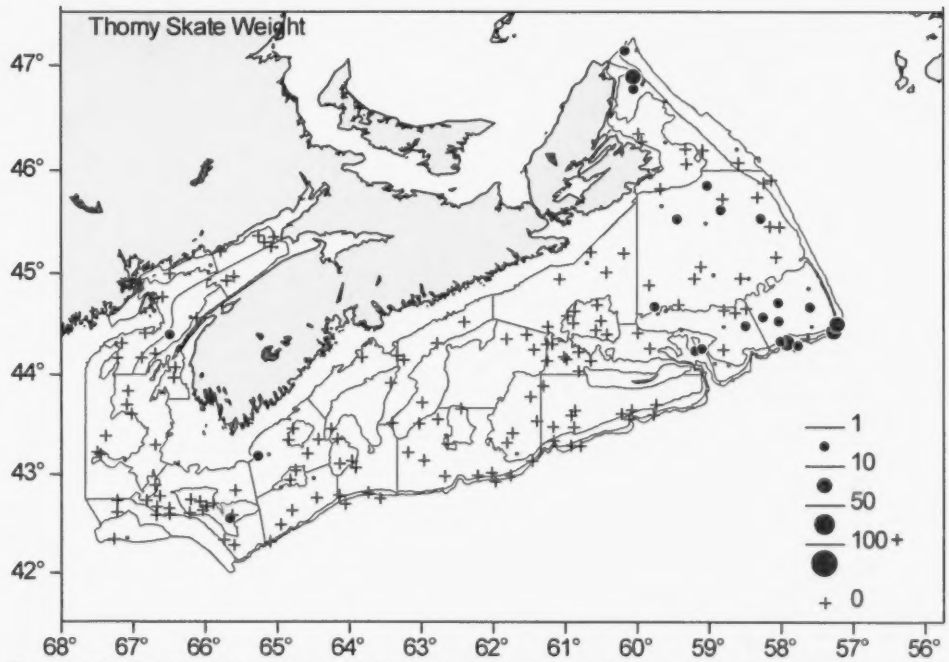

Figure 16a. Distribution of thorny skate catches during the 2009 summer RV survey.

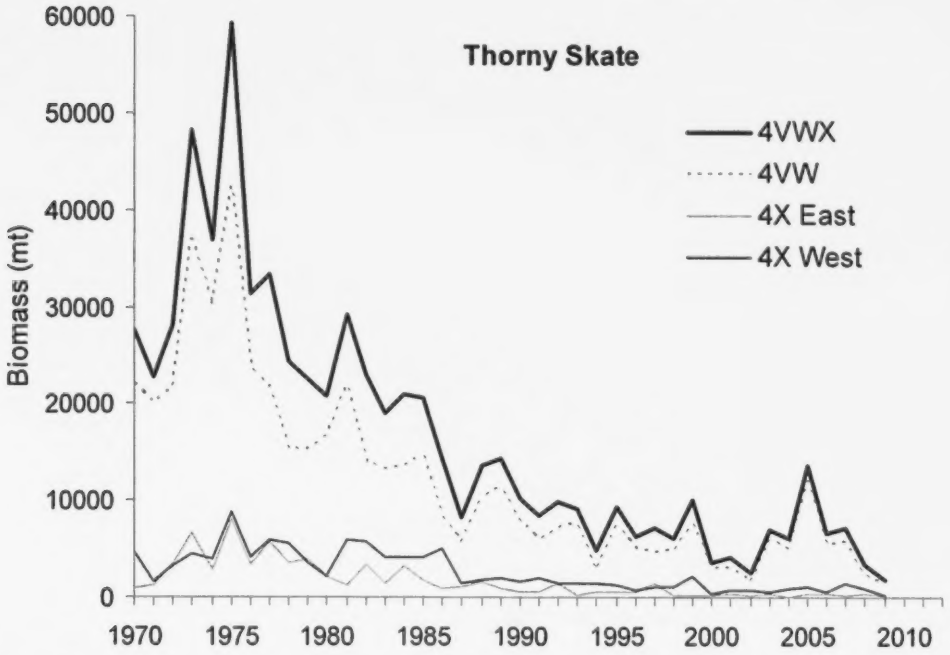

Figure 16b. Biomass estimate for thorny skate from the summer RV survey.

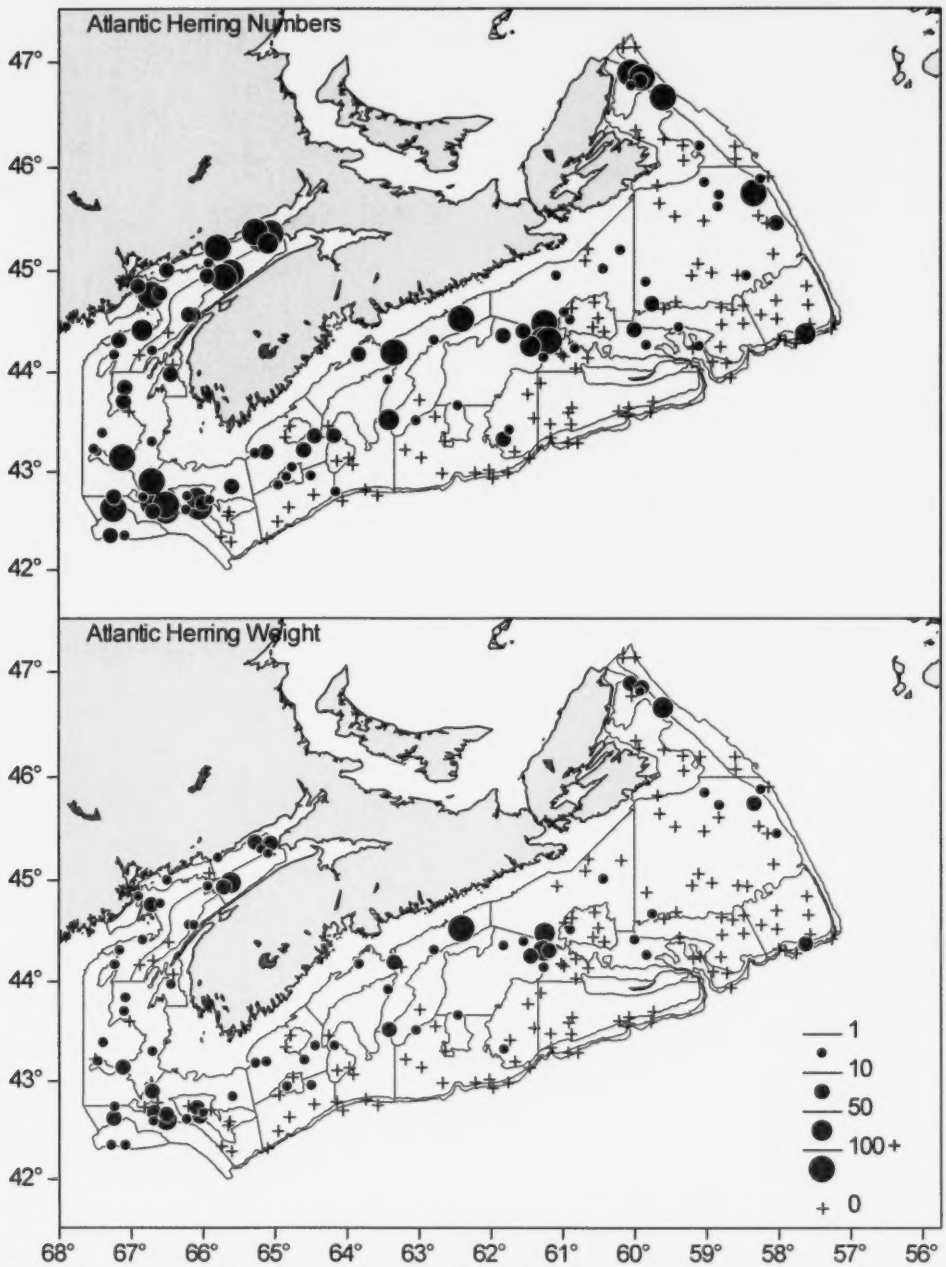

Figure 17a. Distribution of Atlantic herring catches during the 2009 summer RV survey.

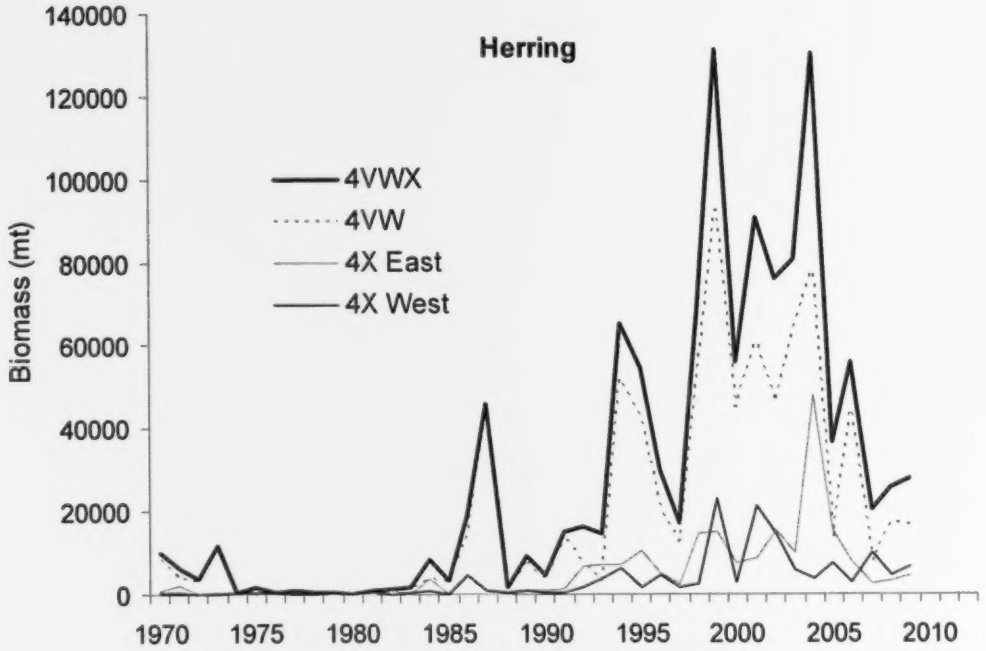

Figure 17b. Biomass estimate for Atlantic herring from the summer RV survey.

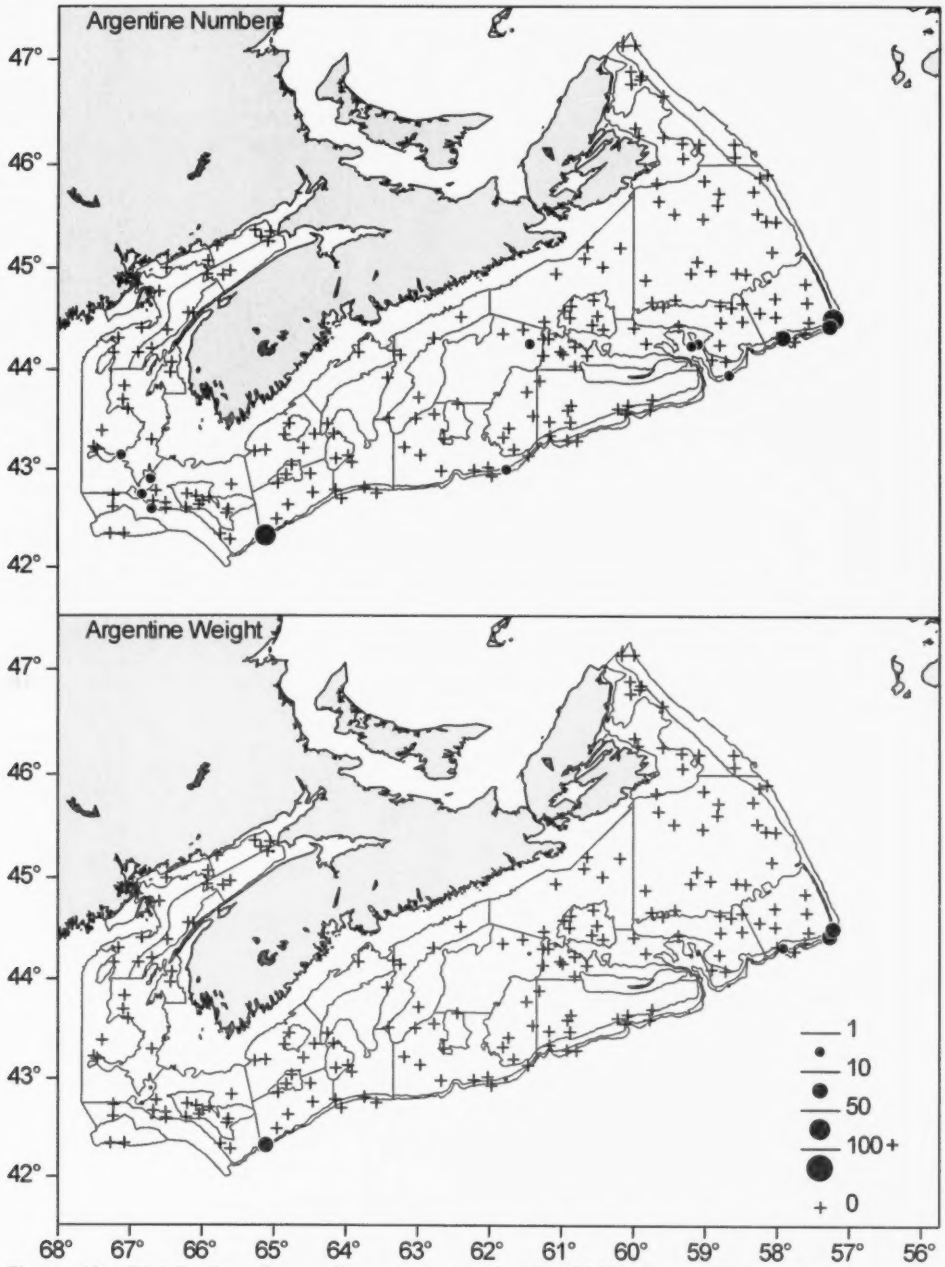

Figure 18a. Distribution of argentine catches during the 2009 summer RV survey.

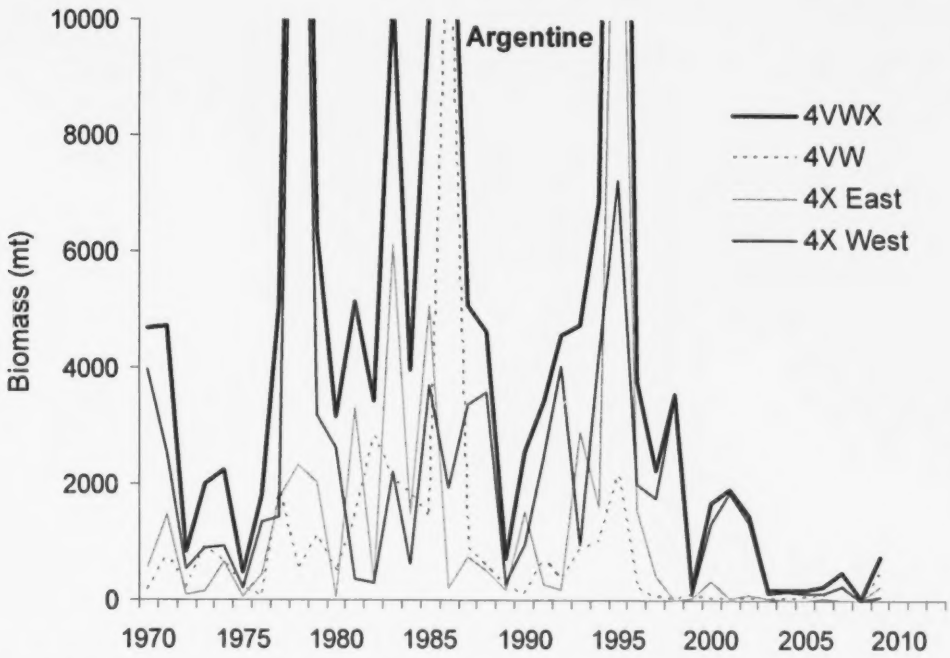

Figure 18b. Biomass estimate for argentine from the summer RV survey.

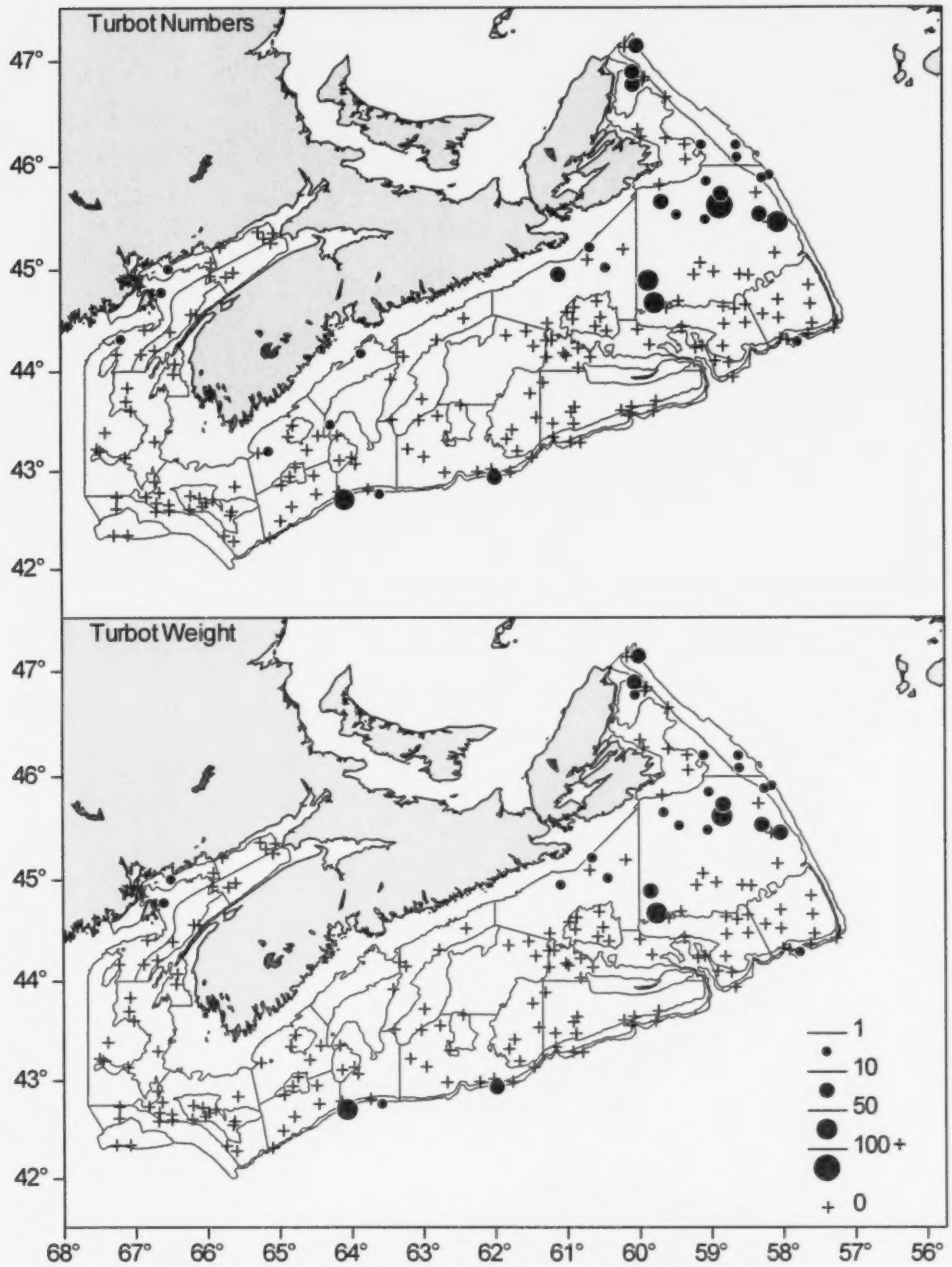

Figure 19a. Distribution of turbot catches during the 2009 summer RV survey.

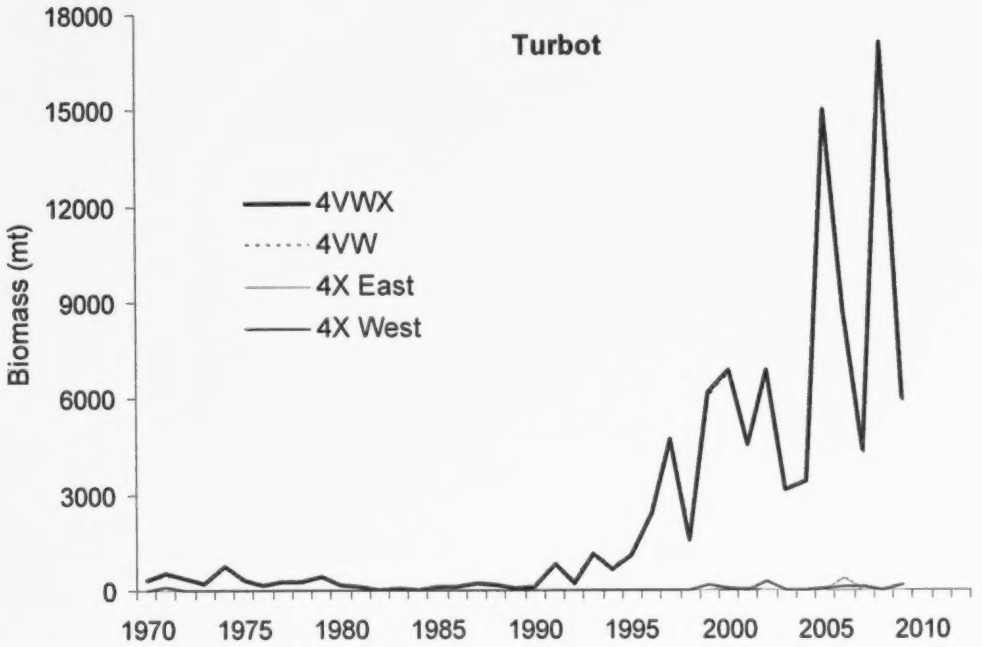

Figure 19b. Biomass estimate for turbot from the summer RV survey.

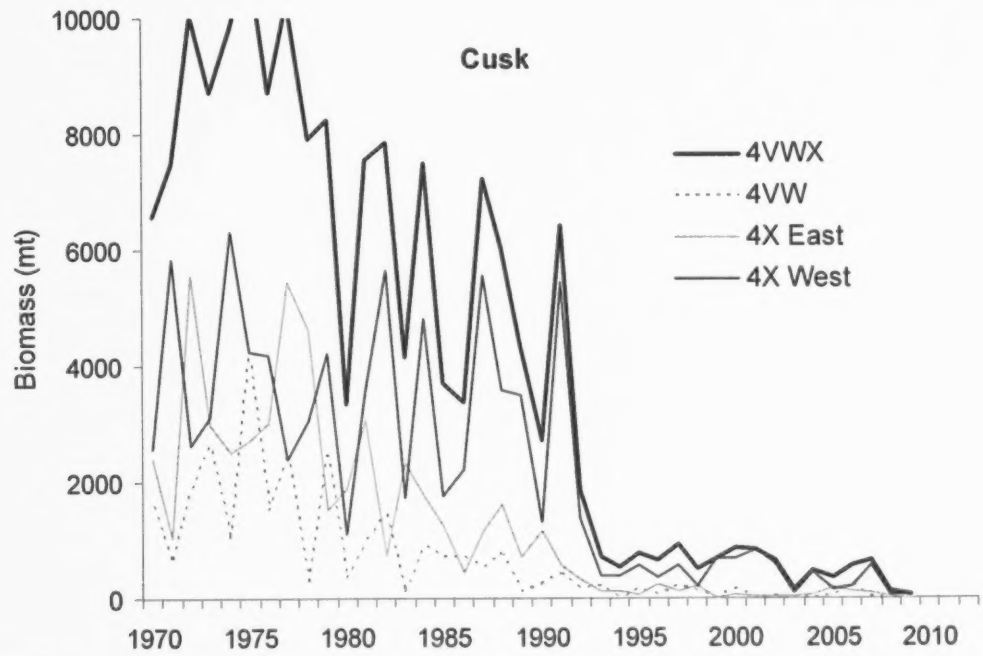

Figure 20. Biomass estimate for cusk from the summer RV survey.

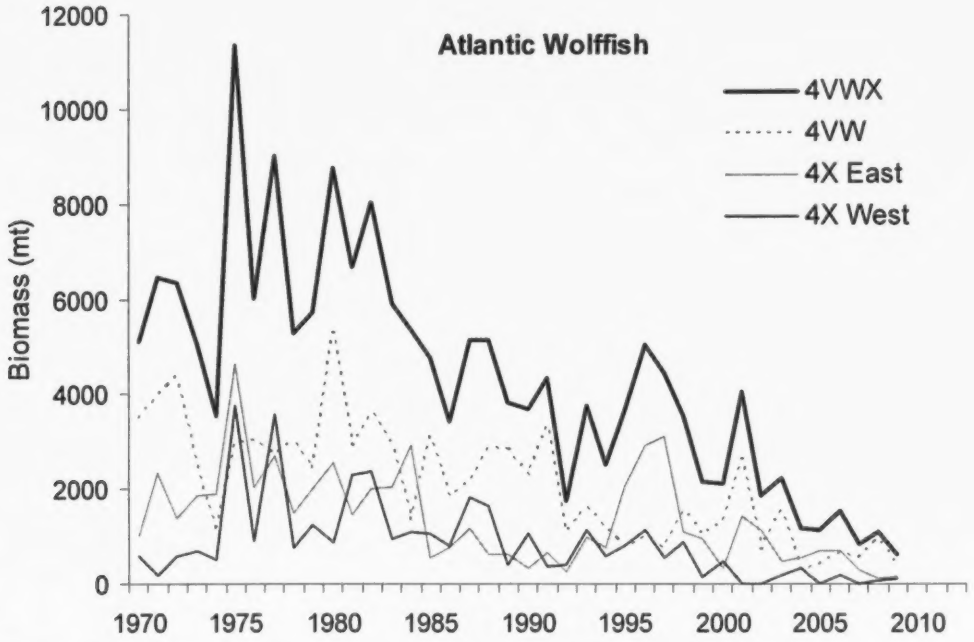

Figure 21. Biomass estimate for Atlantic wolffish from the summer RV survey.

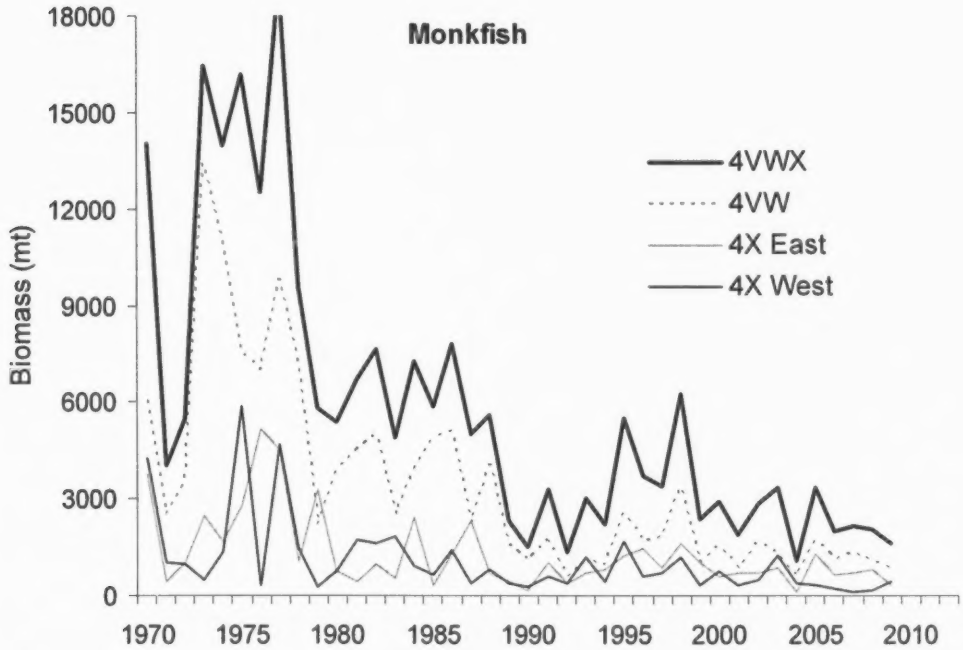

Figure 22. Biomass estimate for monkfish from the summer RV survey.

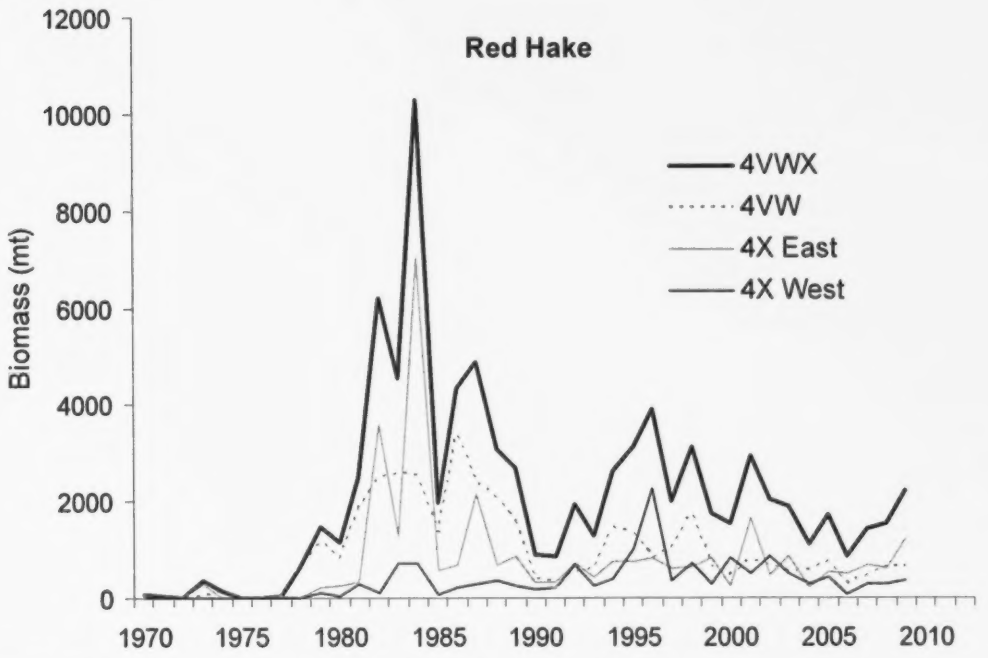

Figure 23. Biomass estimate for red hake from the summer RV survey.

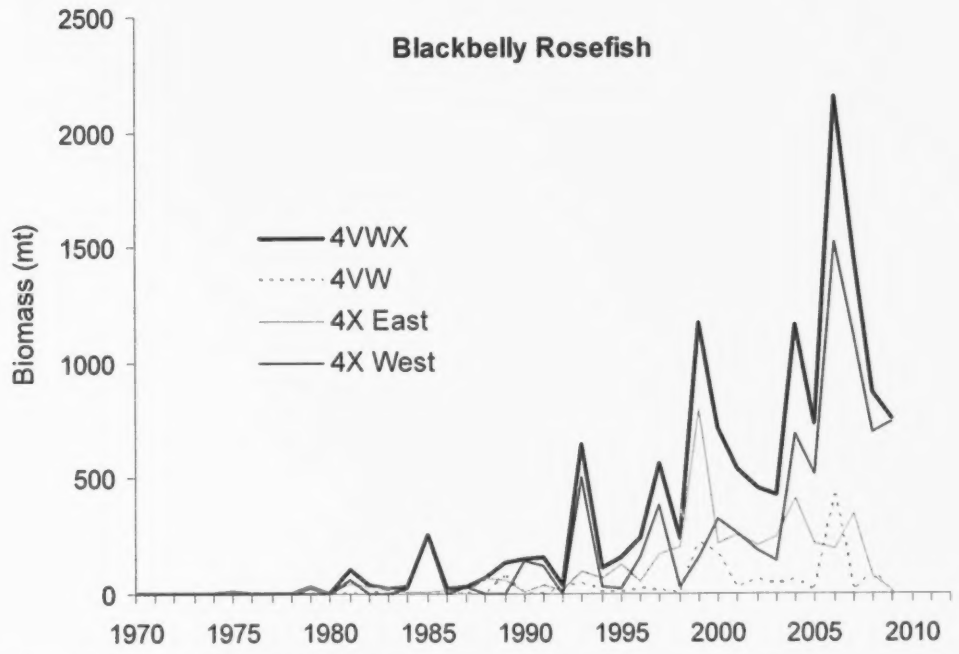

Figure 24. Biomass estimate for black belly rosefish from the summer RV survey.

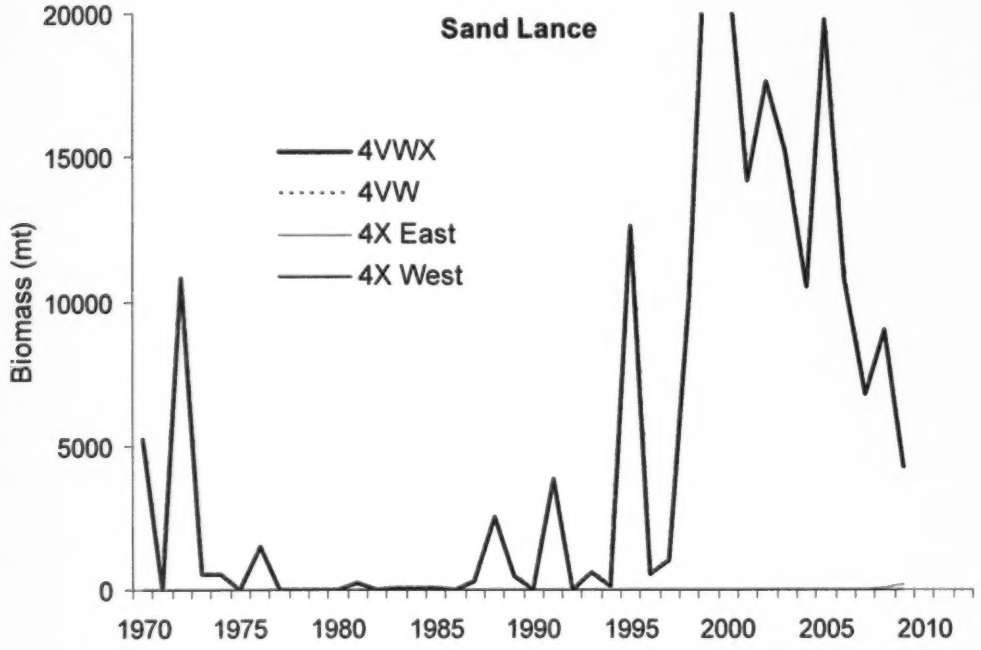

Figure 25. Biomass estimate for northern sand lance from the summer RV survey.

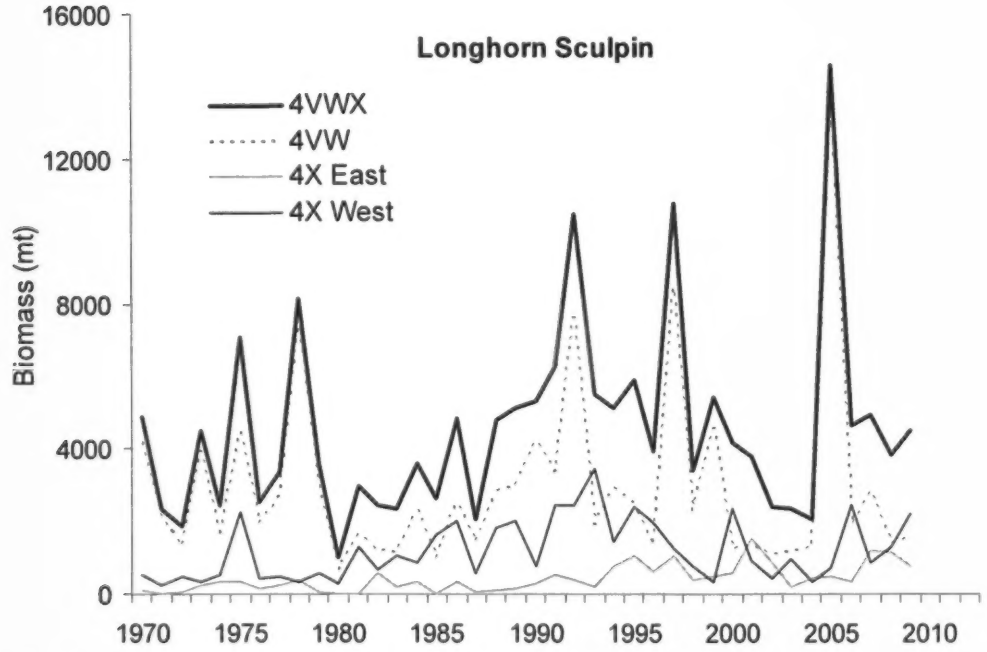

Figure 26. Biomass estimate for longhorn sculpin from the summer RV survey.

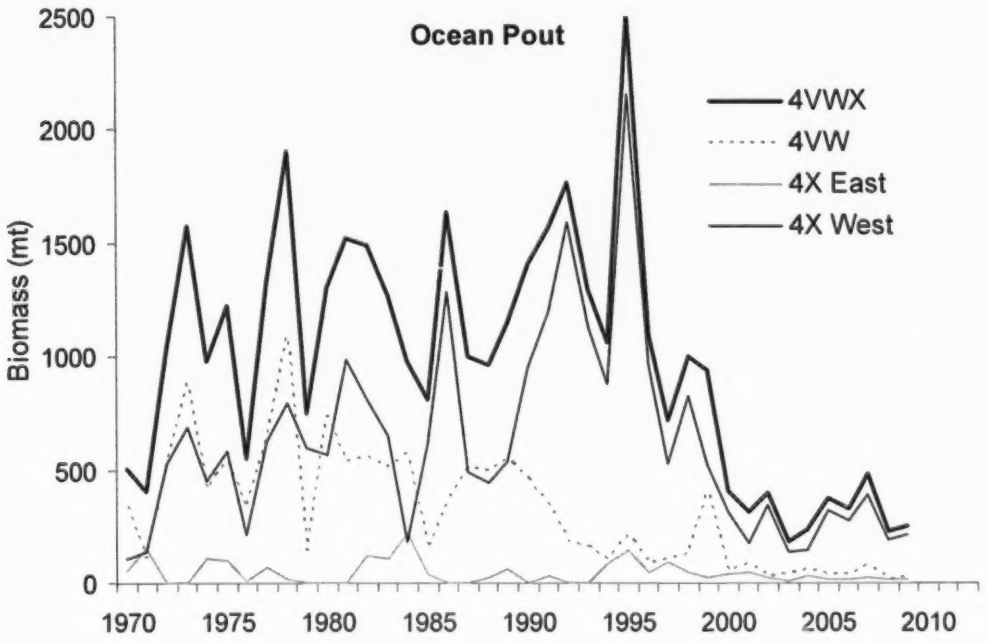

Figure 27. Biomass estimate for ocean pout from the summer RV survey.

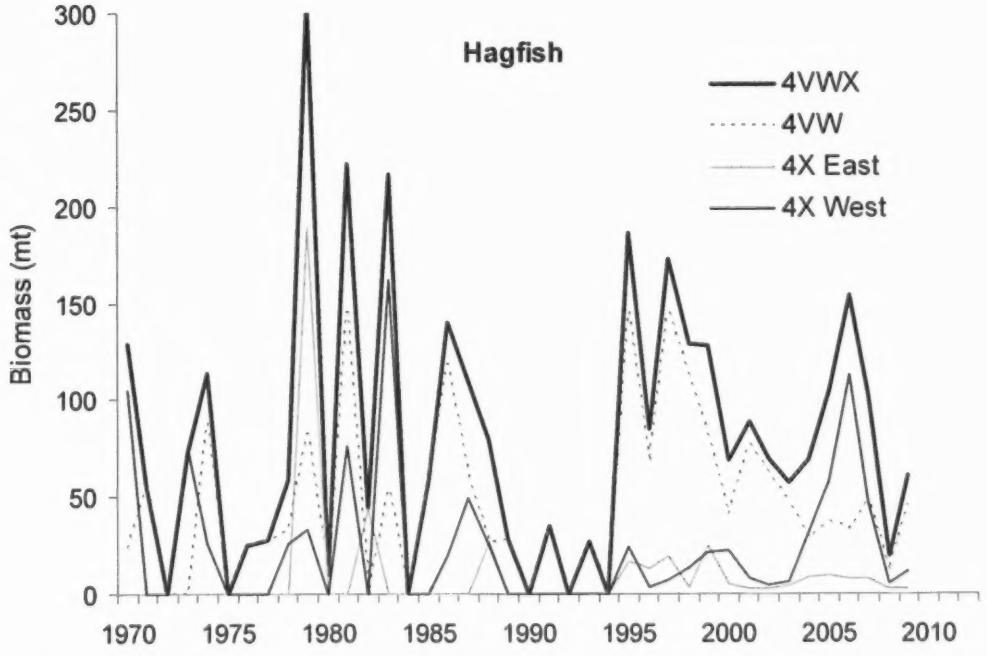

Figure 28. Biomass estimate for northern hagfish from the summer RV survey.

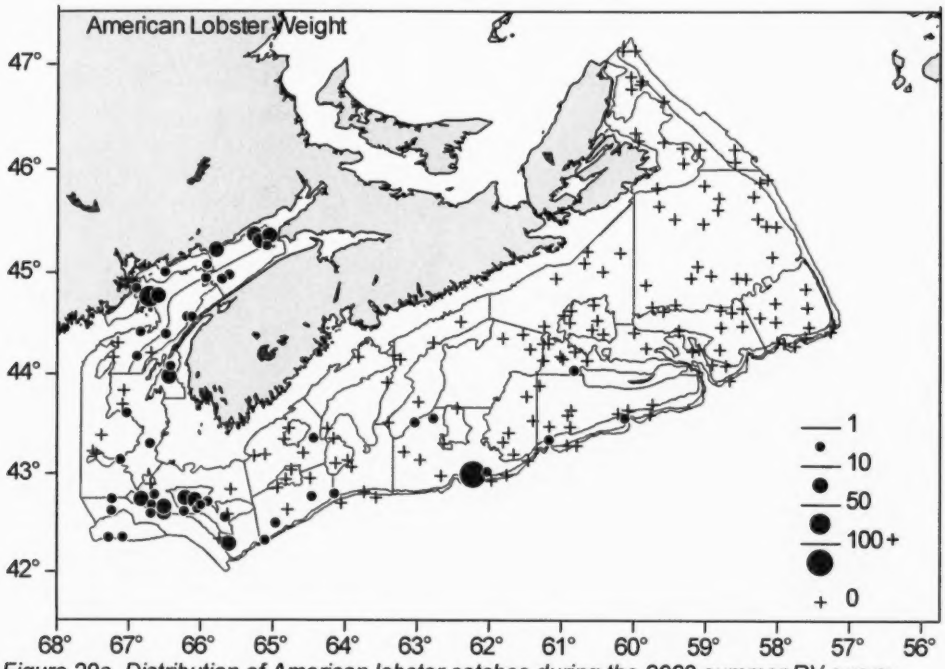

Figure 29a. Distribution of American lobster catches during the 2009 summer RV survey.

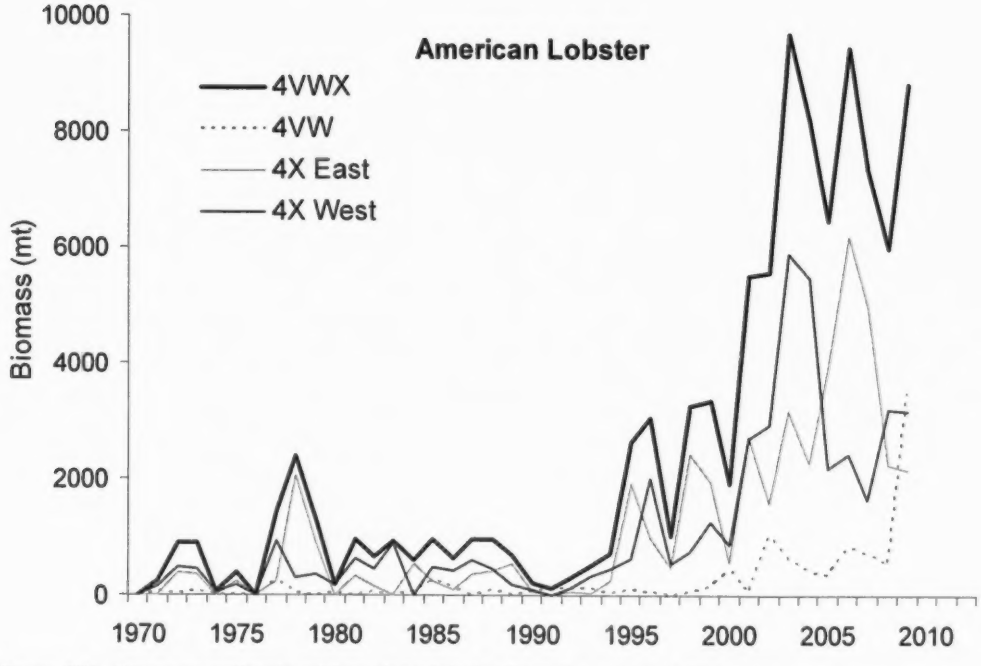

Figure 29b. Biomass estimate of American lobster from the summer RV survey.

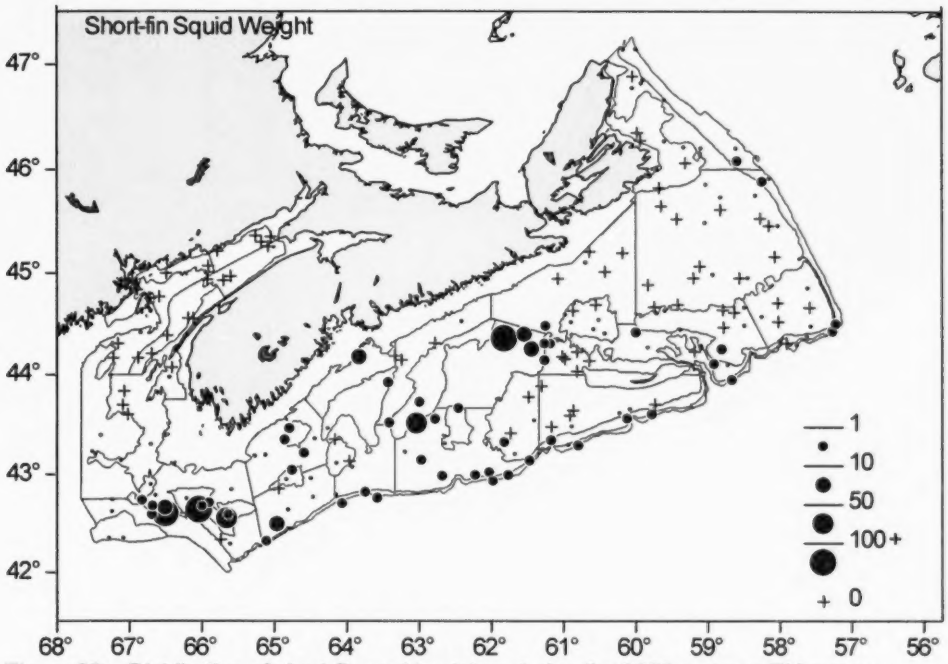

Figure 30a. Distribution of short-fin squid catches during the 2009 summer RV survey.

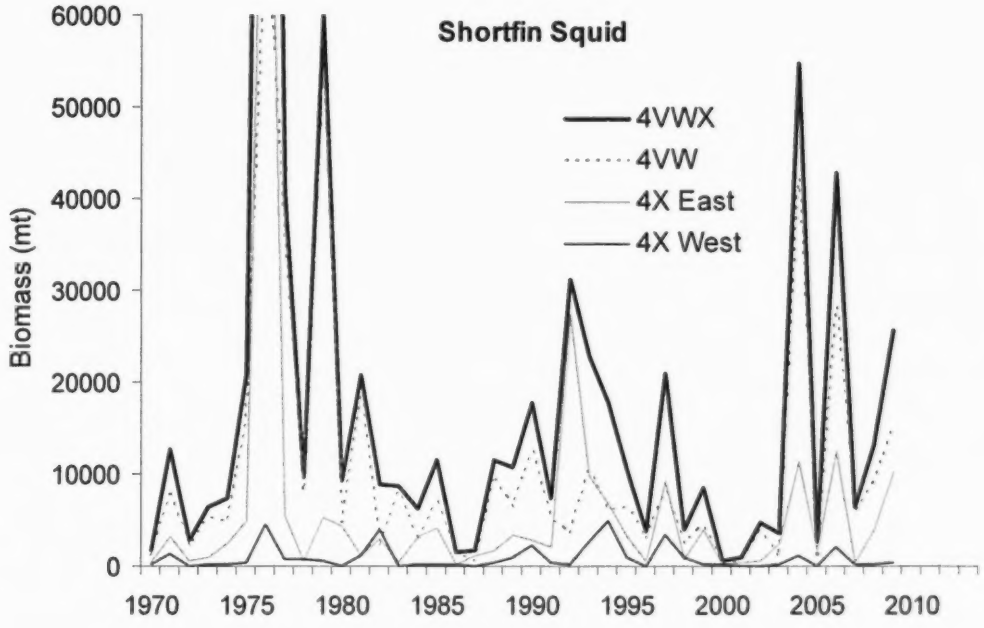

Figure 30b. Biomass estimate for short-fin squid from the summer RV survey.

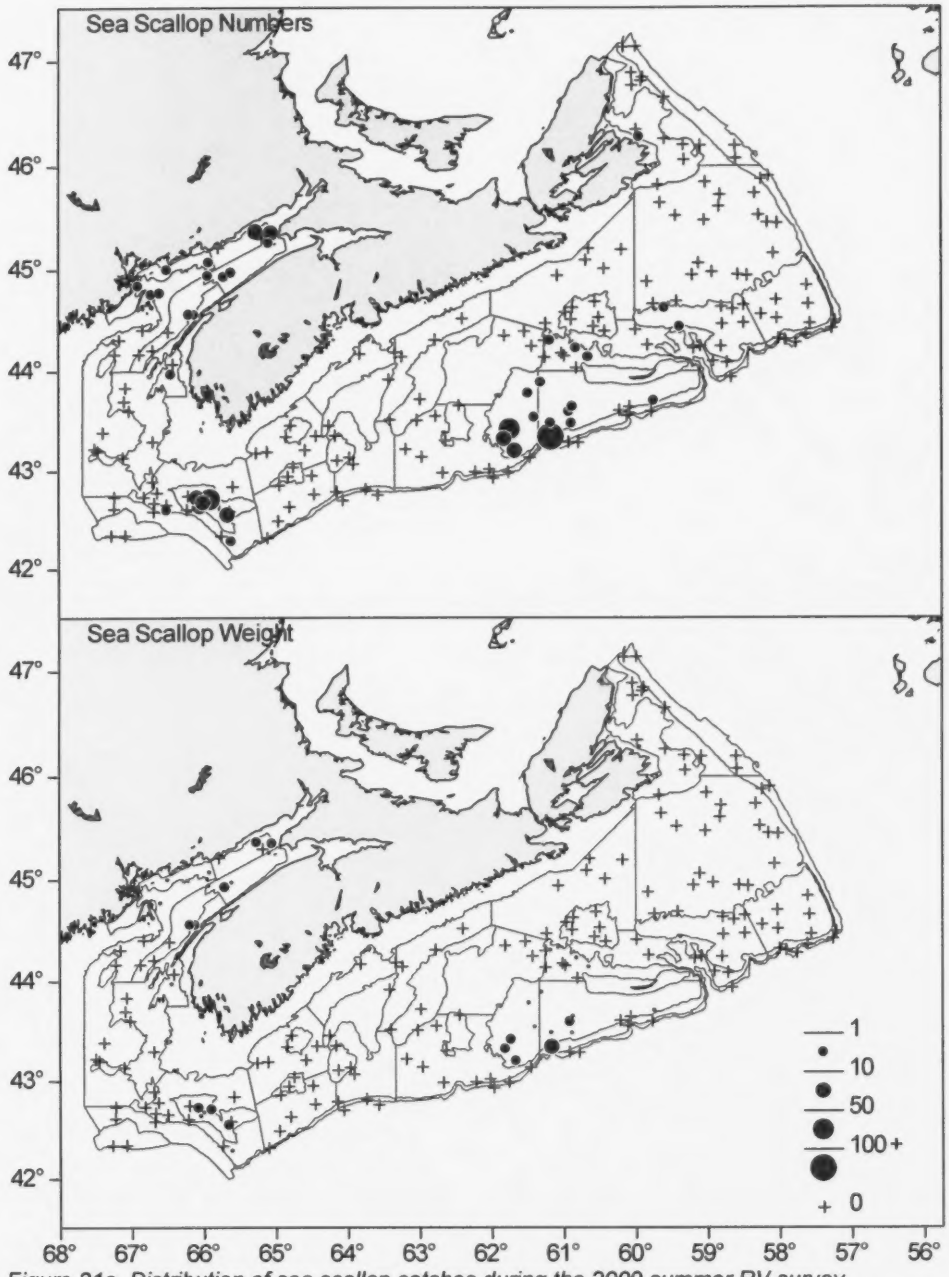

Figure 31a. Distribution of sea scallop catches during the 2009 summer RV survey.

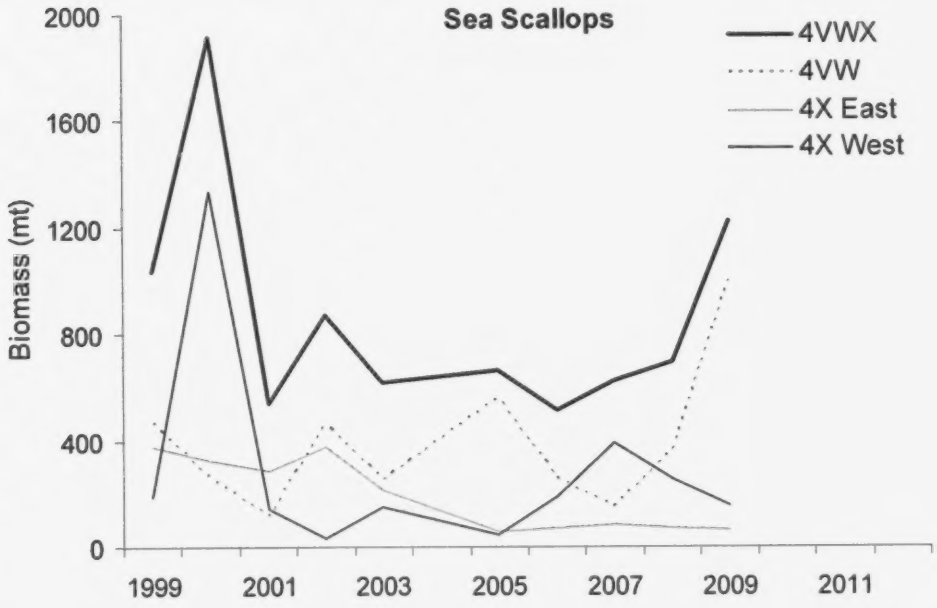

Figure 31b. Biomass estimate for sea scallop from the summer RV survey.

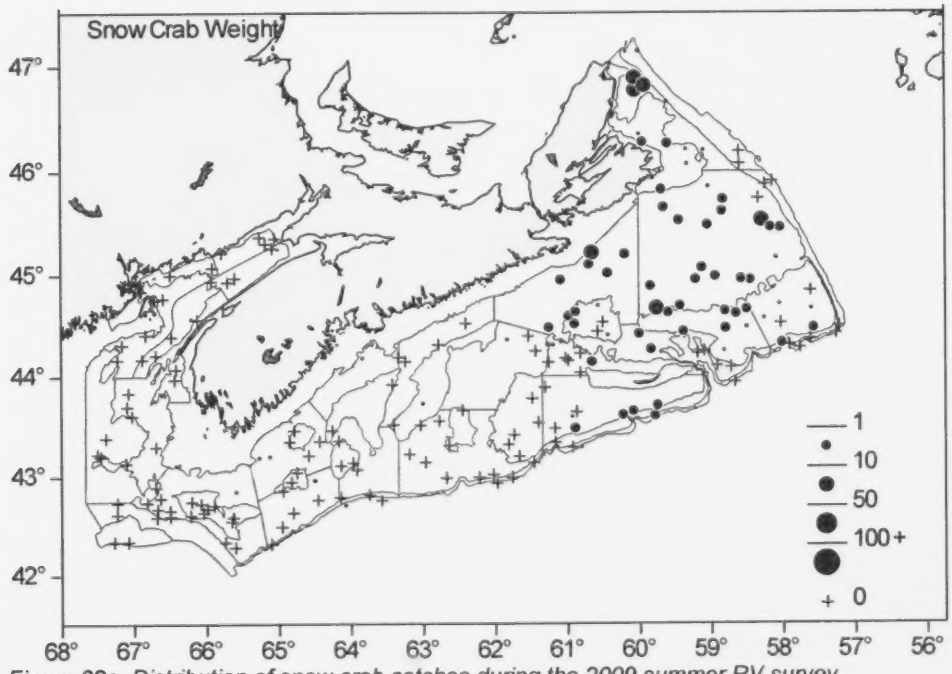

Figure 32a. Distribution of snow crab catches during the 2009 summer RV survey.

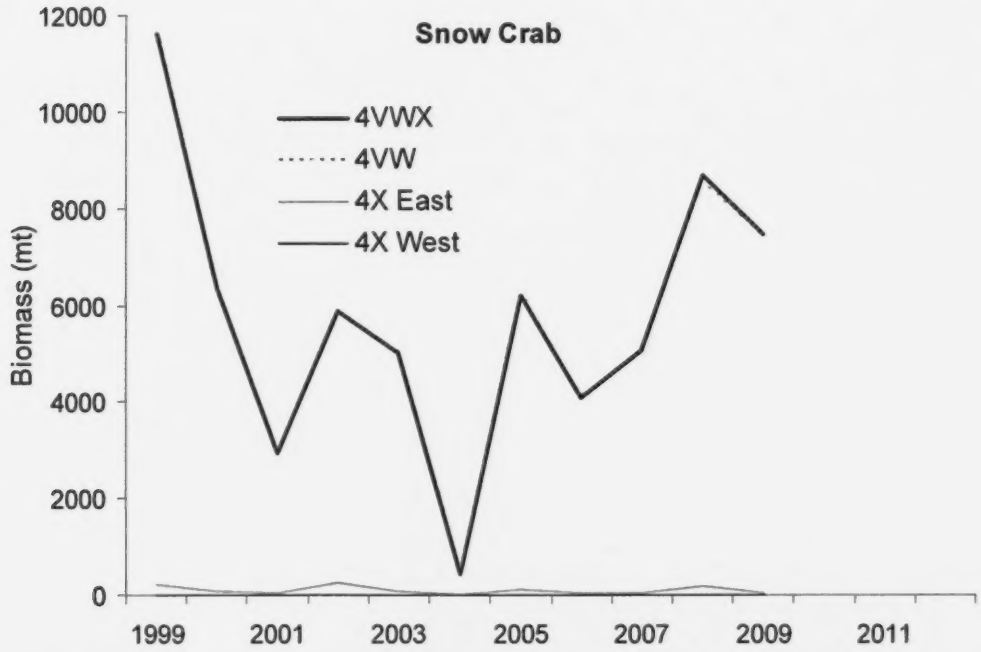

Figure 32b. Biomass estimate for snow crab from the summer RV survey.

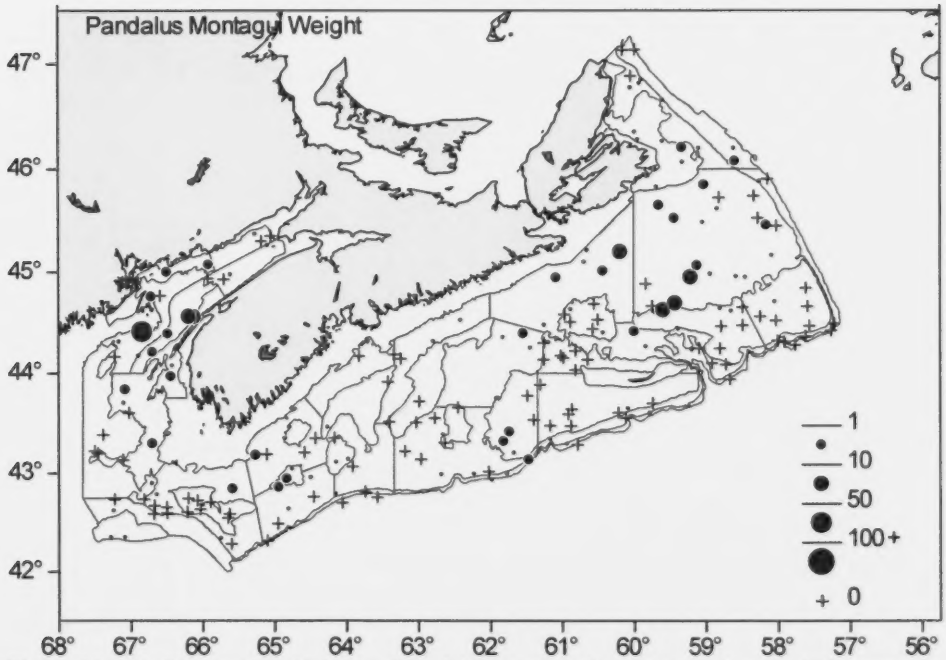

Figure 33. Distribution of pink shrimp (Pandalus montagui) catches during the 2009 summer RV survey.

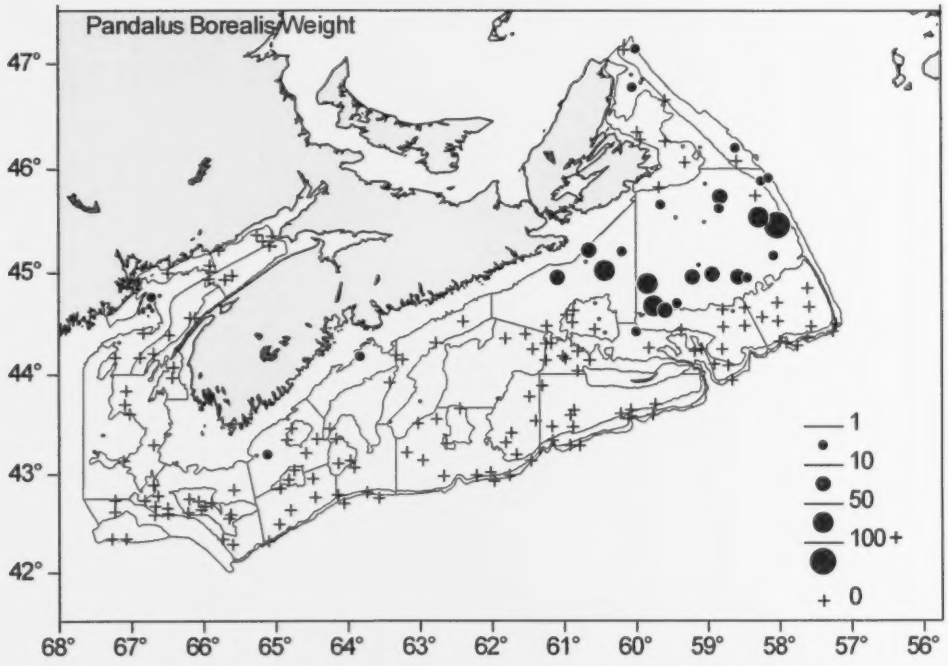

Figure 34. Distribution of northern shrimp (Pandalus borealis) catches during the 2009 summer RV survey.

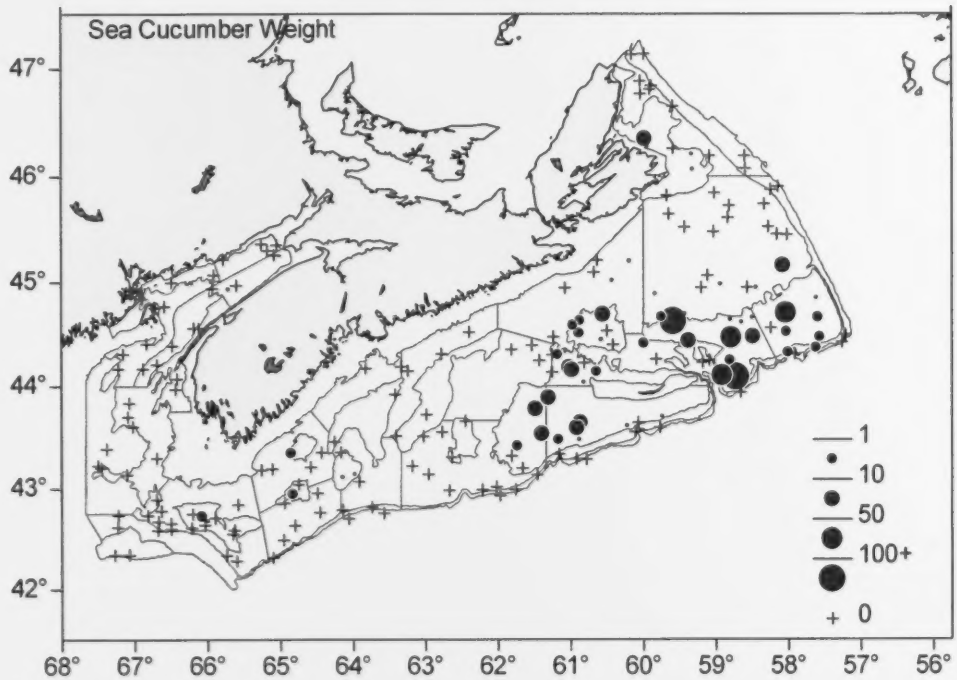

Figure 35a. Distribution of orange footed sea cucumber *(Cucumaria frondosa) catches during the 2009 summer RV survey.*

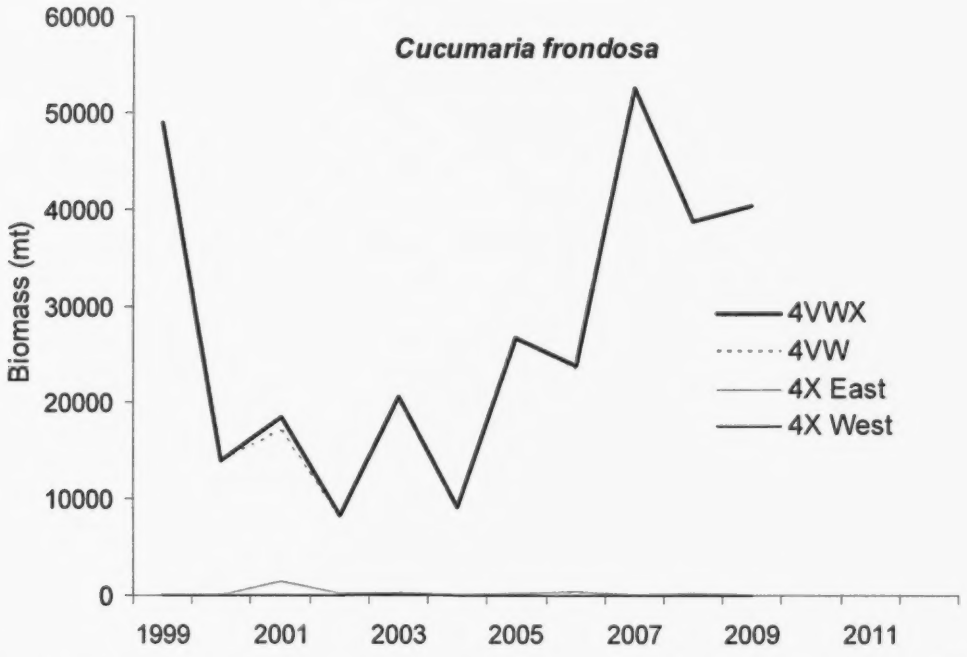

Figure 35b. Biomass estimate for orange footed sea cucumber *(Cucumaria frondosa) from the summer RV survey.*

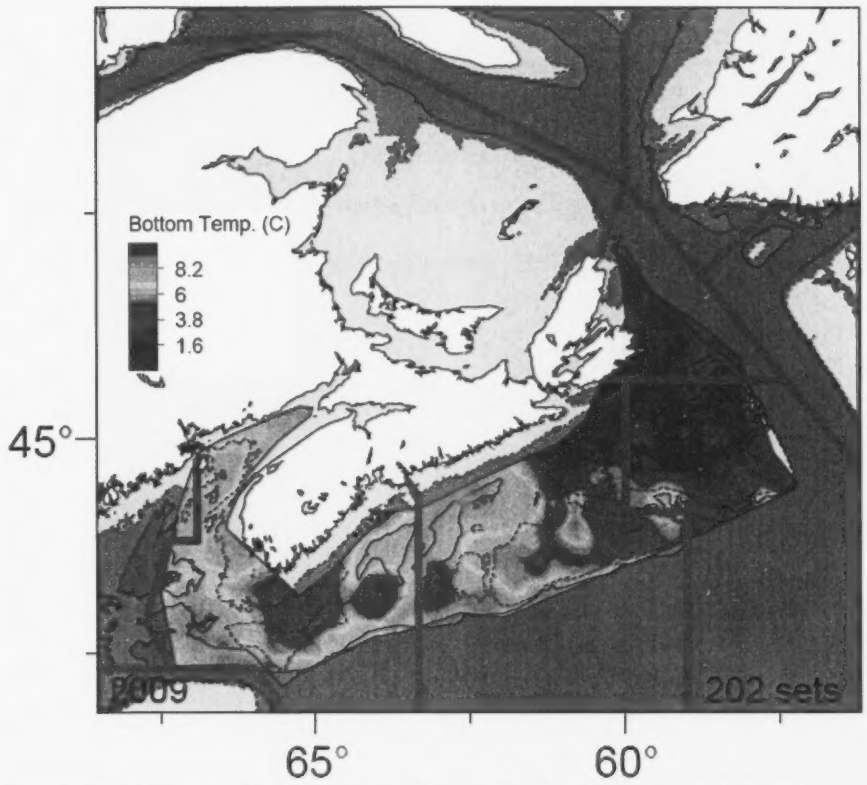

Figure 36a. Bottom temperature distribution from the 2009 summer RV survey.

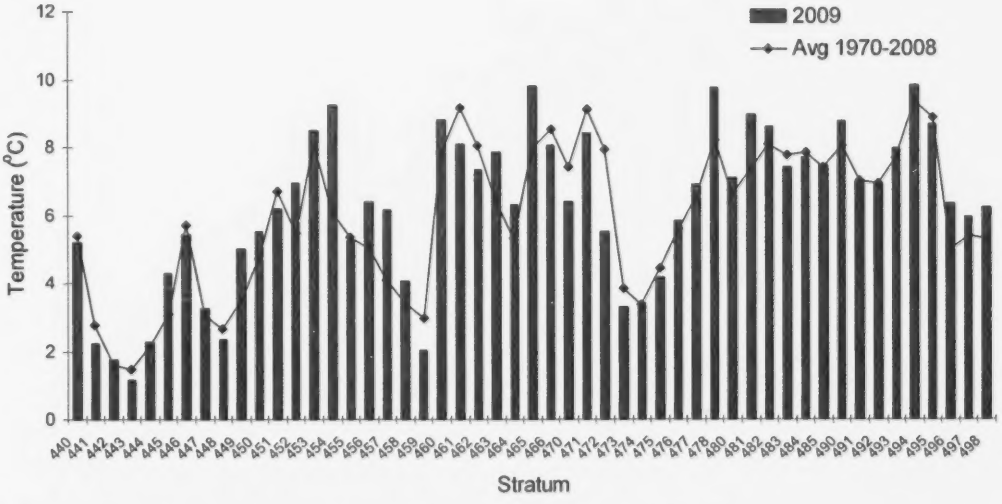

Figure 36b. Average bottom temperatures from the 2009 summer RV survey.

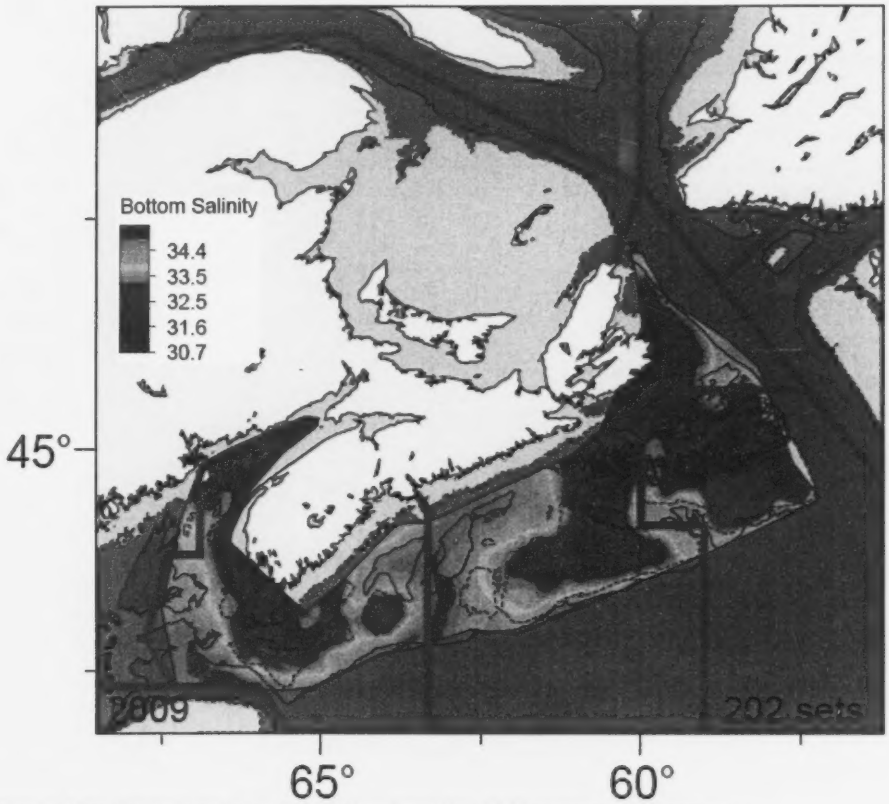

Figure 37a. Bottom salinity distribution from the 2009 summer RV survey.

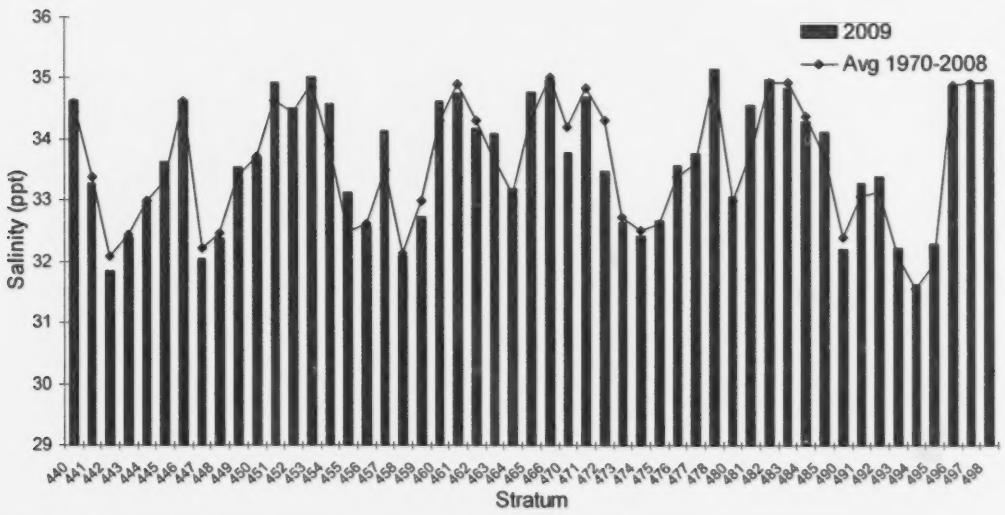

Figure 37b. Average bottom salinity from the 2009 summer RV survey.